"SIX SIGMA AND BEYOND"

A CASE STUDY OF MOTOROLA SEMICONDUCTORS HONG KONG LIMITED

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PREFACE and ACKNOWLEDGMENTS

This case study starts out from one of the CEO Talks organized by the CUMBA program. The speaker is Mr. C.D. Tam, JP, MBE, Senior Vice President & General Manager of the Motorola Asia Pacific Semiconductor Products Group and the topic is on Motorola, with specific reference to its vision and commitment to quality management.

It is a comprehensive and stimulating talk which has aroused our ardent interest to pursue a more thorough and in-depth understanding of what makes the Company's quality management so successful. We would like to express our special thanks to our adviser, Dr. T.S. Lee, who encouraged us to work on the case and introduced us to Mr. Tam. With Mr. Tam's full fledged support, we are then able to embark on our exploration.

In the course of our study, we received a great deal of advice and guidance from Dr. Lee and extensive assistance and tolerance from Mr. Tam and his team of management staff. Without their invaluable comprehensive information this project cannot be made possible.

We would, therefore, like to extend our deepest appreciation and gratitude to all of them, in particular, Mr. Tam, who not only has given us an insightful overview of the issue, but also has directed us to the relevant key staff members for our further in-depth interviews. We are also grateful to Mr. T.L. Ho, Director of Manufacturing Operations, who has provided us with information related to the manufacturing

division; Mr. K.L. Poon, Training Manager, who has given us a concise guide to the various training facilities and implementation of quality management in the Company; Mr. Stephen Ng, Director of Customer Responsiveness Center (CRC) who has presented to us the Quality, Speed and Teamwork Program, the CRC and various dimensions of quality culture. Last but not the least, Mr. H.K. Leung, Director of Reliability and Quality Assurance, who not only has given us a succinct and exhaustive presentation of various quality issues in Motorola, in particular its Quality System Review, but also has invited us to attend the Quarterly Quality and Speed Excellence Review, an eye-opening event which proves to be a valuable and pertinent experience to us in our compilation of this paper.

Poon Lai-King

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ABSTRACT

Motorola has long been regarded as a leading company in the field of quality management. Today, it has excelled itself in achieving the renowned standard of Six Sigma and is constantly looking beyond for greater challenge.

Having a paragon of quality management as the target for study, this Paper, therefore, aims at providing an anatomy of the Company's renowned quality management practices with an attempt to diagnose the various contributing factors leading to its success.

The approach to the case is mainly through interviews with senior management, anaylsis of relevant documentation and non-interfering observation.

The study reveals that Motorola has strived for cultivating a strong quality culture within the Company, which forms a steering force behind its quality improvement movement. The Company has also actively employed various management tools to facilitate its implementation. In addition, it has devised an unique internal quality auditing system, the Quality System Review, to ensure that each process in the business is effective in achieving Total Customer Satisfaction.

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CHAPTER I

INTRODUCTION AND METHODOLOGY

Introduction

In a market with fierce competition and demanding customers, product and service quality is becoming increasingly recognized as the prime consideration in many purchasing decisions. Quality has, in effect, become the cutting edge of competition and the means of increasing market shares. To this end, a lot of companies have dedicated to the development of quality management within their organizations. Amongst them, Motorola is always considered to be one of the leading and outstanding practitioners in this field.

Motorola's achievement in quality management is internationally recognized. The Company has received numerous awards owing to its outstanding performance. Most notably, it won the first Malcolm Baldrige National Quality Award in 1988.

Thus, any further attempt to give an evaluation of the Company's quality achievement may deem redundant and unnecessary. However, it is of particular value to have an understanding of what constitutes to its success, how it approaches the concept, and how it works. These are the issues we will address.

To put it simply, the objective of this paper is to provide a full account of and an insight into HOW the Company accomplishes such outstanding quality performance. Particular reference to the Motorola Semiconductors Hong Kong Ltd. will be drawn.

Organization of the Paper

The first Chapter is Introduction and Methodology, which provides the general background of the subject and the basic approach and scope of the case study.

Chapter II gives an overview of the Company background.

Chapter III provides a historical countdown of the development of quality management in Motorola. It unfolds the various stages the Company has undergone.

Chapter IV gives an explanation of what Six Sigma stands for and why the Company uses it as a quality goal.

Chapter V investigates the many facets of quality culture in the Company and explores how the Company uses it to glue its workforce in sharing the same quality values.

Chapter VI covers the implementation of quality management in Motorola. It introduces a few tools employed by the Company such as QuST, Total Productive Maintenance, Total Control Methodology and '5S' Housekeeping rules.

Chapter VII looks into some concrete success cases for quality improvement in the Company. They are the best demonstration of the Company's achievement in quality management.

Chapter VIII introduces Motorola's unique quality auditing system, the Quality System Review (QSR). It also presents a cross reference between the QSR and the ISO System. Finally, the Chapter looks closely into three subsystems i.e. the Human Resources Involvement, the Quality System Management and the Customer Satisfaction Assessment.

Lastly, Chapter IX provides a conclusion.

The Approach

The methodologies used for data collection and fact finding include documentation, archival records, interviews, site visit and non-interfering participation.

Among all these, interviews are the most important means to gather information. Altogether five interviews have been conducted. The interviewees include:

- Mr. C.D. Tam, JP, MBE
  Senior Vice President & General Manager
- Mr. T.L. Ho
  Director, Manufacturing Operations
- Mr. H.K. Leung
  Director, Reliability & Quality Assurance

- Mr. Stephen Ng
  Director, Customer Responsiveness Center
- Mr. K.L. Poon
  Training Manager

A brief touring of the work site at the Silicon Harbour Center was also conducted.

However, to the two authors, the most useful experience and the strongest impact come from their attending the Fourth Quarter Quality and Speed Excellence Review in 1993.

In such occasion, we have the opportunity to meet a number of Motorolans from different divisions covering both manufacturing and non-manufacturing areas. We found that all the Motorolans present talked in an earnest and proud manner on their successful experiences in quality improvement and it has erased our doubts towards non-managerial staff's commitment to quality improvement. They have illustrated their remarkable team spirit and commitment to the work improvement quality culture. The occasion represents one of the best testimony of what the Company preaches.

CHAPTER II

COMPANY PROFILE

Introduction

Motorola is one of the world's leading providers of wireless communications, semiconductor and advanced electronics technology for worldwide markets. Its products include two-way radios, pagers, personal communications systems, cellular telephones and systems, discrete semiconductors and integrated circuits, defense and aerospace electronics, automotive and industrial electronics, computers, data communications and information processing and handling equipment.

In 1992, the Company has approximately 107,000 employees worldwide; ranks 32nd on the Fortune 500 list and 11th in total U.S. exports.

Motorola has major facilities in ten states in the U.S. and Puerto Rico, and maintains more than thirty others outside the U.S. The Company is listed on the New York, Midwest, London and Tokyo Stock Exchanges.

History

The Company was founded by Mr. Paul V. Galvin in 1928 as the Galvin Manufacturing Corp. in Chicago. Its first product was a "battery eliminator",

allowing consumers to operate radios directly from household current instead of the batteries supplied with early models. In the 1930s, the Company successfully commercialized car radios under the brand name "Motorola". During this period, the Company also established home radio and police radio departments and began national advertising. The name of the Company was changed to Motorola, Inc. in 1947 - a decade that also saw the Company enter government work and open a research laboratory in Phoenix, Arizona, to explore solid-state electronics.

By the time of Mr. Paul Galvin's death in 1959, Motorola was a leader in military, space and commercial communications. The Company was also in the business of consumer electronics and had built its first semiconductor production facility.

Under the leadership of Mr. Robert W. Galvin, son of Mr. Paul Galvin, Motorola expanded into international markets in the 1960s, and began shifting its focus away from consumer electronics. The color television receiver business was sold in the mid-1970s, allowing Motorola to concentrate on high-technology markets in commercial, industrial and government fields. In recent years, Motorola's fundamental strengths in electronics technologies at both the component and equipment levels have been evident in the Company's sales growth and business mix which are covered in the next section.

Operating and Financial Results

Sales for 1993 was up by 28% to US$17.0 billion from US$13.3 billion in 1992 whereas net earnings were US$1.02 billion compared with US$576 million a year earlier. The Company spent US$1.52 billion in 1993 in research and development, as compared with the investment of US$1.31 billion in 1992.

International market sales, as measured by the locale of the end customer, represented 54% of total sales in 1993, compared with 52% a year ago and is expected by the Company to grow to 65% in five years' time. The corresponding figures in 1988 and 1985 are 36% and 27% respectively.

Organization and Management

The Company's operations are highly decentralized, with business operations structured as sectors, groups or divisions, depending on size. There are currently four sectors and four groups as listed below. In addition, there is the New Enterprises Organization which manages Motorola's entry into strategically relevant, emerging, high-growth and high-technology worldwide business arenas.

Sectors

1. Semiconductor Products Sector;
2. Land Mobile Products Sector;
3. General Systems Sector; and
4. Messaging, Information and Media Sector.

Groups

1. Government and Systems Technology Group;
2. Information Systems Group; and
3. Automotive, Energy and Controls Group.

All of Motorola's businesses report to an Office of the Chief Executive, which includes the Chairman of the Board and Chief Executive Officer; the President and

Chief Operating Officer; and the Senior Executive Vice President and Assistant Chief Operating Officer. Mr. Robert W. Galvin is still servicing as Chairman of the Executive Committee of the Board of Directors.

The subject of this case study is Motorola Semiconductors Hong Kong Limited which is naturally the focus of discussions from this point onward. However, as policies and practices are derived from the Headquarters, references to the Motorola Inc. as a whole would be made in the discussions of corporate culture and macro systems.

Motorola Asia Pacific Semiconductor Group

Motorola ranks the third largest semiconductor company in the world, just behind Intel and Toshiba. The Company is also the second largest in North America and third in Asia Pacific electronics industries.

Among Motorola's many chip customers in Asia are such high-profile multinationals as General Motors, Apple Computer and Goldstar, along with other local firms, only some percentages of the chips are for internal Motorola's business use.

The Asia Pacific Semiconductor Group's terrain includes sales offices in South Korea, Taiwan , Malaysia, Singapore, Philippines and Australia where there are about 6,000 employees. Motorola has a very advanced manufacturing facility in Hong Kong and has also started its investments in China recently. Its 209,000 square feet Phase One facility in Tianjin has just begun pilot operations in late 1993. By 1995, when the second phase of construction completes, the Company will occupy a total of 716,000 square feet at the Tianjin Economic & Technologic Development Area.

Also, the Motorola Innovation Center and IC Design Center will be established in Singapore this year.

Motorola Semiconductors Hong Kong Limited ("Motorola-HK")

Motorola-HK, founded in 1967, is a wholly-owned subsidiary of Motorola Inc. and the headquarters of the corporation's Asia Pacific Semiconductor Products Group, which in turn is part of the greater Semiconductor Products Sector. Motorola-HK designs and produces a broad line of integrated circuits, including microprocessors, micro-controllers, for use in the computer, consumer, automotive, industrial, and telecommunications market.

In 1968, there was only one executive and his secretary to handle the semiconductor business of Motorola's Hong Kong office which housed about 60 employees. The profile of a typical customer then was a small, local radio manufacturer for whom quality and integrity were not paramount. The semiconductor business has changed radically since then, mushrooming into a US$46 billion-a-year industry. The Asia-Pacific region is now the fastest growing part of the world for chip consumption. In 1993, Motorola's regional sales rose 40%.

Motorola-HK has 1,200 employees in September 1989, 1,755 in April 1992 and 2,400 in October 1993. The total staff comprises over 1,200 engineers, professionals and support staff. The rest are employed as direct labor in the Company's two highly automated seven-day-a-week and three-shift round-the-clock plants.

There are two facilities in Hong Kong, and are located in Kwai Chung and Tai Po respectively:

The Profit Building Plant in Kwai Chung is a 112,000 square foot facility in a multi-story building and was acquired in 1982. It comprises a manufacturing line for microprocessor products and the regional Hong Kong/China sales office.

The Silicon Harbour Center, a 326,000-square-foot plant on 7.2 acres, located at the Tai Po Industrial Estate on the waterfront next to the Tolo Harbour, was completed in December 1990. The initial project cost is believed to be in excess of US$50 million. The facility houses the Company's Asia Pacific headquarters, its regional computer center and its regional integrated circuit design center and a manufacturing center which is fully automated and linked via a fiber optic local area network and a high speed satellite with the Company's global operations.

CHAPTER III

EVOLUTION OF QUALITY MANAGEMENT IN MOTOROLA

Introduction

The era of quality management in Motorola begins more than a decade ago which synchronizes an era of rapid development of the semi-conductor industry. What the companies in the industry have been competing are not only in their product innovation, strategic planning, marketing program, but above all, in their quality management. Quality has emerged from a matter of survival to a competitive weapon for the key players in such a highly competitive industry. To Motorola, it has been translated into a real challenge - the challenge of quality that becomes part of the life of every Motorolan.

Motorola's Quality Improvement Stages

The Awakening (1979-1981)

According to Crosby's Quality Management Maturity Grid, when a company's quality development enters into the awakening stage, its leaders become aware that "there was a better way, that it might be open to them, and that they could do something about it." (Crosby. Quality is Free, p. 49)

This is exactly what happened at Motorola in 1979.

Everything started in an officers' meeting in 1979 when certain officers reported that too many customers were dissatisfied with several quality offerings and some competitors were outperforming the Company in certain products.

The above remarks created an uproar among top level management. The Company was paying a high price for non-conformance without knowing how to resolve it. However, they knew that they should and could do something about it. From this point onward, the subject of quality became the focus of the Company's development plan. This is the awakening stage - a stage of recognizing one's deficiency in quality management and a stage which sown seeds for future development.

Another typical trait of a company in the awakening stage is that it is neither ready to strive whole-heartedly for long-range quality solutions nor committed to a full-fledged quality expectation.

Similarly, we can see that what Motorola had achieved in this period was a consensus of the purposes and a recognition from the top management on the importance of quality management. However, it did not put forward detailed direction of where the Company should head to and how the challenge should be tackled. Quality programs were conducted in a piecemeal and unstructured fashion. The end result was less than satisfactory.

The Enlightenment/The Wisdom (1981-1986)

1981-1986 was the critical years for Motorola to take its quality journey from the awakening via the enlightenment to the perimeter of the wisdom stage.

In 1981, Motorola established the corporate goal of improving quality by ten times by 1986 i.e. the renowned *Five Year, Tenfold Improvement Program.* This goal called for reducing the level of defects of products to one-tenth the base-time level. It meant that no matter what operation a Motorolan was in, no matter what his present level of quality performance was, whether it was a service department or a manufacturing arm, it was the goal of the Company to have him improved by that magnitude in five years.

This is precisely the stage of the enlightenment in Crosby's Management Grid. "The stage appears with the decision to go ahead and really conduct a formal, regulation, card-carrying quality improvement program." (Crosby. Quality is Free, p. 34)

It was a fragile beginning. The first reaction by some managers was that of skepticism. "We don't know what it means." "We don't know how to achieve such goal." However, as this is a corporate goal fully committed by top management, there were searches for ways to improve quality.

In fact, changes had inevitably forced its way through the Company. Some new methods were engineered. Some step functions were altered. Some new concepts were adopted. However, the most outstanding achievement in this period was that the Company finally established a common language to be used for quality measurement. It marked the beginning of its wisdom stage where "the company has the chance to make the changes permanent" and "the attitude, the systems, and the enthusiasm are all there waiting." (Crosby. Quality is Free, p. 35)

Motorola operates through many different business divisions. The distinct differences in the nature of its business divisions led to the development of different

measurements of quality level. Therefore, the greatest challenge which the top management faced at that time was to make internal assessment to determine whether the performance made by one unit was equivalent to that made by another as the measurements were made in different terms.

This prompted the creation of a single simple term for measuring quality. Thus, during the second half of 1985, with one-and-a-half years to go in this five year program, the concept of "Total Defects per Unit" was introduced. This provided a common vocabulary in all quality discussions as the definition was uniform throughout the Company.

Defect:	Any single reason that caused customer dissatisfaction
Unit:	Any unit of work or whatever output a division produced

This term greatly enhanced the works of the management in measuring and comparing the rates of quality improvement of different divisions because the goal of defect reduction was uniformly applied to all operations. This consolidation in the uses of quality measurement is a milestone for the subsequent development of the Company's quality culture.

The Wisdom /The Certainty (1987-1992)

The five-year program ended with success in 1986 when the 10 times improvement rate was largely attained and the market share of the Company increased for the first time in ten years. However, the quest for quality remained an uphill battle for Motorola as the strength and toughness of its competitors were also growing.

It now became clear to the top management that only by achieving Total Customer Satisfaction would the Company be able to become a global leader in the industry. Thus, in January 1987, Motorola restated its corporate goal to be :

> "Improve product and services quality ten times by 1989, and at least one hundred fold by 1991. Achieve Six Sigma capability by 1992. With a deep sense of urgency, spread dedication to quality to every facet of the corporation, and achieve a culture of continual improvement to assure Total Customer Satisfaction. There is only one ultimate goal: zero defects - in everything we do."
>
> - Bob Galvin, January 17, 1987

This was the time when the new term "Six Sigma - Six Sigma by 1992" was introduced. The concept will be elaborated in the subsequent chapter. In short and brief, it is a drive for perfection as the defect rate is just 3.4 parts per million. Virtually, it is a standard to perfection.

In the process, the Company had undergone a series of fundamental changes. First, quality was then identified as the top priority for action permeated meeting agendas, planning, reviews, training, compensation and rewards. An integrated approach was adopted in the Company's restructuring and redefining relevant functions. Regular quality system reviews were established. Revolutionary changes in the standard, process, and system, all the way from what to design to how to design, what to produce to how to produce, etc. were abound. And, above all, every person in the Company speaks the same quality language. Everyone pursues his or her own job version of Six Sigma, and everyone shares a sense of what it means. In effect, the Six Sigma process succeeds in changing the way people do things.

This marks the certainty stage for quality management in Motorola. - "Quality management is to be considered as an absolutely vital part of company management." (p.36, Quality is Free, Crosby).

For most parts, the Company met the goals of 10 times improvement by 1989 and 100 times by 1991. Several Motorola facilities exceeded Six Sigma capability. In financial term, the Company saved an amount of US$700 million in the cost of manufacturing during 1991 and US$2.2 billion since the beginning of the Six Sigma process.

Its achievement was also internationally recognized. The Company was awarded the 1988 Malcolm Baldrige U.S. National Quality Award in recognition of its superior company-wide management of quality processes. It was also the only four-time winner of the DataQuest "Semiconductor Supplier of the Year" Award for the years from 1989 to 1992 for its "extraordinary dedication to quality products and service".

The Certainty and the Way Forward (1992 -)

In January 1992, when the Six Sigma concept is no longer a myth but an achievable goal to the Motorolans, Mr. George Fisher, the then Company's CEO pointed out, in a letter to the employees, that "when we do reach Six Sigma, however, there is still rooms for improvement." Instead of parts-per-million level, the top management projected a vision of producing quality at a parts-per-billion level as the product complexity of semiconductor chips continued to increase.

Thus, analogical to the product life cycle, Motorola's quality management has reached its maturity or what Crosby put as the certainty stage in 1992. From then on, instead of allowing the Company to stay stagnant or to decline, the top management

has put forward another set of goals to instill new elements and new life in its quest for perfection. They are the goals for the Company to strive for in meeting tomorrow's challenges:

"• Achieve Six Sigma and beyond results in everything we do; strive for 10-times reduction in defects every 2 years.

• Achieve 10-times cycle time reduction in 5 years.

• Develop indices and measure customer satisfiers in each business, then set and achieve aggressive goals."

- George Fisher, Gary Tooker, Christopher Galvin, January 1992.

Here, the Company has added a new parameter in its value, TIME, which calls for a new dimension in its quality culture - the culture of speed improvements. This concept will be further elaborated in subsequent chapter.

The word Quality has become the way of life for the Motorolans and will be for them in the future. Whilst quality demand itself is not a static issue, we expect that continuous improvement remains the central theme in Motorola's management practice. As what Crosby put, they will "DO IT OVER AGAIN!"

Motorola - HK

It is Motorola's fundamental belief that everyone must commit to and follow the Company's values regardless of location. It is up to the manager in each location to execute the Company's objectives to suit the local culture.

At Motorola-HK, with the foresight of its leader, Mr. C.D. Tam, quality management has been following suit in what has happened in the Headquarters. Nevertheless, the Hong Kong-based Company succeeded in bringing about a cultural adaptation - a combination of the best of East and West to give the Company the competitive edge. According to Mr. C.D. Tam, the unique quality management of the Asia Pacific Group is based on a fundamental belief - "that the meticulous, productive and strategic mentality of the East, combined with the innovative, assertive and flexible thinking of the West, together create a synergy of ideas and working practices which in turn promote advanced technology and provide total customer satisfaction worldwide".

In the following chapters, we will explore some of the Company's eastern approaches to quality, among which the monthly shark's fin soup is the most prominent and frequently quoted example of an eastern approach in recognition of quality standard.

Whilst the Motorola Headquarters was awarded the Malcolm Baldrige U.S. National Quality Award in 1988, the Motorola Semiconductors HK Ltd. has also won numerous awards in recognition of its outstanding achievement in quality management. To name a few: The 1990 Hong Kong Governor's Award for Productivity, the 1991 Hong Kong Governor's Certificate of Merit for Industry - Quality and the 1992 Asian Management Awards in "General Management" and "People Development & Management" presented by the Asian Institute of Management.

In fact, the Hong Kong Automated Assembly in the Profit Building Plant in Kwai Fong is the first Motorola site to achieve Six Sigma assembly yield performance for all packages, in spite of the fact that the equipment there is not as modern as in other areas. The site was honored with the CEO Award - the highest honor for quality

excellent performance bestowed on an individual, a team, an operation or any deserving unit by the CEO of Motorola. On June 26, 1993, a ceremony was held in the Silicon Harbour Center to recognize the team for their dedication and achievements. The award was presented by the then Chairman of the Board and CEO of Motorola Inc., Mr. George Fisher.

CHAPTER IV

QUALITY GOAL - THE SIX SIGMA

Any discussion on quality management in Motorola will become fragmentary without mentioning its renowned quality goal - the Six Sigma. This is a flagship of the Company's never-ending quality improvement journey and a unique approach taken by the Company to achieve its fundamental objective - Total Customer Satisfaction.

As mentioned in Chapter Three, the Six Sigma goal was introduced in 1987. It was a commitment by the top management at that time to achieve a quality goal of 10-times improvement by 1989, 100-times improvement by 1991 and Six Sigma capability by 1992. As what Crobsy put forward, this is the step of 'goal setting' taken by the top management 'to turn pledges and commitments into action by encouraging individuals to establish improvement goals for themselves and their groups.'

Since then, a Six Sigma culture has been cultivated throughout the Company. Simultaneously, a distinctive Six Sigma corporate logo was developed, Six Sigma posters and banners were put up at the most noticeable areas, Six Sigma training courses and handouts were designed and delivered. (Motorola's extensive elaboration of its quality culture will be discussed later.) In effect, the two words, Six Sigma, have become the two most frequently used vocabulary within the Company.

In fact, the adoption of Six Sigma as a quality goal should be considered as the major factor contributing to the Company's great leap in quality management. Six Sigma is a concept relatively easy to understand, remember and be identified by individual staff member. It therefore becomes the top management's most effective tool to develop new plans and activities on quality improvement. For the Motorolans, Six Sigma enables them to communicate in a common language on quality issues. Six Sigma also serves as a standard for measuring quality performance and setting common quality goals. As a result, the Six Sigma concept glues the Company into a powerful united force in pursuit of quality perfection. It has blatantly changed the way the Motorolans do things and has helped the Company to achieve a quality standard internationally recognized.

The Six Sigma Concept

By using Six Sigma as a quality goal, the top management in Motorola intended to quantify quality in statistical measurement.

Sigma, in its simple term, stands for standard deviation, which measures how far away the mean values lie. Six sigma means six standard deviations from a statistical average which means 99.99966% defect free. It is not yet absolutely zero, but it does signify 3.4 parts per million defect level for the total process. The graphical representation of sigma is shown in Appendix 1.

Thus, the process for the implementation of the concept begins by recording the defects found in every single function of activities. The reporting methods are straightforward. They are expressed in terms of 'Total Defects per Unit'. It is a common measurement which directly correlates to customer satisfaction. The 'Total Defects per Unit' are then related to the number of opportunities in making such

defects in the products or in the process. As indicated in the graphical presentation, Six Sigma translates into 3.4 defects per million opportunities. By contrast, Five Sigma is 233 defects per million, and Four Sigma is 6,210. As can be seen, Six Sigma is a major step towards zero defect.

The concept of Six Sigma not only applies in manufacturing process, but also plays an important role in non-manufacturing work tasks such as design, marketing and accounting. Taking the security guards at the entrance in the Silicon Harbour Center as an example. Their job is to make sure that the right people get in quickly and if there are problems, to handle them professionally. Thus, defect is measured with respect to a customer complaint and in this particular context, a customer is anyone who comes to the Center.

Concurrently, the suppliers are also involved in the Six Sigma goal setting process to ensure that they will deliver products with minimum variation from the original design and specifications. The management's ultimate objective, however, is to enable their staff to relate it to their personal endeavor so that the concept will permeate in everything they do.

Six Steps to Six Sigma

To assist the Motorolans in achieving the Six Sigma goal, the Company has developed the 'Six Steps to Six Sigmas', a systematic sequence to analyze the causes for defects and then work out improvement plans. Details of the 'Six Steps to Six Sigmas' will be elaborated in Chapter VI, Implementation of Quality Management.

Six Sigma and Beyond

As stated in Chapter III, by 1992, Six Sigma is no longer a myth but a reality to the Motorolans. As at to date, quite a number of facilities in Motorola did exceed Six Sigma capability.

In order to strive for continuous quality improvement, the top management has already revised its quality improvement goal in 1992 to 'Six Sigma and Beyond'. The Company now aims 'to achieve Six Sigma and Beyond in everything we do; strive for a 10-times reduction in defects every two years.' In statistical term, the Company is no longer looking at the unit of 'million' for defect opportunities. Instead they are upgrading the level to 'BILLION'!

CHAPTER V

QUALITY CULTURE

The success of quality management in Motorola demonstrates that whilst an effective quality control system is essential in sustaining and upgrading the quality level of an organization, the management's conscious effort in creating an atmosphere, a common language, symbols, rituals and beliefs in quality is the determinant factor to its success and unique competitive advantage.

Such a conscious effort targets in inducing every Motorolan to share a set of common quality values, and, ultimately, in building up a coherent and dominant quality culture within the Company.

The Notion of Quality Culture

> "Culture within an organization is the pattern of basic assumptions that a given group has invented, discovered or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid and therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems." (Schein of MIT, 1984)

Quality culture, stated briefly, is a mental program which embodies the values and beliefs in quality. Such values and beliefs are to be shared by members of the organization. They affect their attitudes and behavior. In other words, culture provides the framework for the way things are and should be within the organization. The values in quality will be articulated, shared and passed on within the organization and will in turn be symbolically manifested in a number of ways. Corporate logos and mission statements; stories, rituals, and ceremonies; hero figures; even the physical design of the organization all carry the expression of the quality culture. At the same time, the practices and methods adopted by the organization are also affected by it. Hence, the compensation system, the decision-making mechanisms and other practices all possess elements constituting the quality culture.

In this chapter, we will diagnose the many facets of quality culture in Motorola and how it has been cultivated throughout the entire Company.

Shared Values and Assumptions

The fundamental element of a quality culture is the Company's underpinning beliefs and values, which provide direction in governing staff members' behavior and thinking. Once they identify with the company's values and beliefs, then work will mean more than just eight hours a day and money in their pockets.

In this respect, Motorola has clearly exhibited strong corporate values and beliefs within the Company. The top management formally formulated a full set of company objectives, beliefs, goals and key initiatives in 1987.

Fundamental objective: Total Customer Satisfaction

Key beliefs: Constant Respect for People
Uncompromising Integrity

Key goals: Increased Global Market Share
Best in Class (people, technology, marketing, product, manufacturing, service)

As can be seen, quality is always the central theme in the Company's values and beliefs and the focus of all efforts. Such a strong message in quality lays a solid foundation for its quality culture to nurture and prosper.

For the Motorola Semiconductor Unit, the top management has specifically developed a formal policy statement printed as a handout for all the staff:

> "It is the policy of Motorola Semiconductor Products Sector to produce products and provide services which meet or exceed customer expectations, specifications and delivery schedule.
>
> Our system is based on prevention utilizing proactive quality systems. The goal is continuous improvement, beyond Six Sigma, to achieve error-free performance and Total Customer Satisfaction.
>
> These results come from a culture of empowerment for all in a participative, cooperative and creative workforce."
>
> - signed by Mr. Thomas D. George, President and General Manager and Mr. Murray A. Goldman, Senior Vice President and Assistant General Manager of the Semiconductor Products Sector

The values are lucid and the concerns are all there. It is again the pursuit of quality and customer satisfaction that matters the Semiconductor Sector. The Company's strong commitment to quality serves as an indicator to all staff members as to where the Company is heading through quality management, and, thus, a sense of unity with each other gradually developed.

Specifically for the region, the Motorola Asia Pacific has also developed a mission statement in the summer of 1992, which states that:

> "Asia Pacific Group shall be perceived by customers (external and internal) and employees as the world's most responsive and trustworthy semiconductors company.
>
> - By consistently providing the highest quality products and services faster than any of our competitors.
> - By committing to all employees the best training in the industry; by creating an environment for growth opportunity and the most satisfying job experience.
> - By achieving a good financial return to the group, corporation and shareholders."
>
> - Summer 1992

The above statement explicitly explains the nature of its business and what its targeted market position is - "as the world's most responsive and trustworthy semiconductors company." Also, it explains the Company's attitude towards its staff, customers and shareholders, and, above all, its commitment to quality.

Moreover, this 1992 mission statement reveals that quality improvement has become a way of life of the Motorolans so much so that it is no more a challenge thus they are now looking for something beyond. The inclusion of the time element in the Company's values as signified by the statement "By consistently providing the highest quality products and services **faster** than any of our competitors." is yet another indicator codifying the continuous improvement of its quality program.

Top Management's Commitment

Virtually every quality management concept demands top management's commitment as a prerequisite for success. As Deming says, it is the role of management to define and design the system and to do so in a way that builds in quality. Crobsy in his renowned Fourteen Steps ranks "management commitment" as the first step to quality management. Deming's Fourteen Points also include "a structure in top management". They, together with many academics and consultants, all recommend that without commitment from the top, quality program is not worth starting.

In Motorola, the involvement of top management in quality was there from the very beginning. Mr. Bob Galvin himself believed that unless top managers gave quality greater attention, quality program would bound to fail. It was reported that he insisted that quality reports came first, not last, on the agenda, and then he left before the financial results were discussed.

In fact, the Company's Policy Committee is composed of top managers in the corporation. They develop the goals and therefore subscribe to it whole-heartedly. Also, the CEO chairs the Operating and Policy Committees twice a quarter. And the

Company recognizes any individual or sector's superior contribution to improved quality by the CEO Quality Award which is normally presented by the CEO himself. Only through the CEO's direct involvement in regular task forces and together with other strong and persistent acts by top management will any skepticism towards top management's commitment to quality vanish.

The Company's vigorous development of quality policy / mission statement has already signified top management's commitment to quality program. It is leadership that formulates the set of values and beliefs, brings Motorolans together under a shared vision and sets it in motion, and, ultimately, it constructs a quality culture for Motorola.

Organization

At Motorola-HK, the departments that are directly related to quality management include:

- Reliability and Quality Assurance Department
- Quality, Speed and Teamwork Program ("QuST")
- Customer Responsiveness Center

A detailed organizational chart was attached in Appendix 2.

The Reliability and Quality Assurance Department is primarily the quality audit department of the Company. It is responsible for fostering the implementation of the Motorola Quality Review System and orchestrating the ISO certification process. Whilst it is the backbone for controlling and upgrading quality standard, it also acts as a catalyst to transmit the message of quality across the Company.

However, the set-up which is solely responsible for culture engineering in Motorola is the QuST which was kicked off four years ago. As stated clearly in the QuST Charter, the ultimate objective of QuST is "to promote quality, speed and teamwork culture across the organization". Thus, this cross-functional team is the main driving force in changing, improving and creating culture elements.

The team is composed of departmental directors, managers and employees from different departments who form themselves into different domains and join different champions which are areas for quality improvement. QuST's work and functions will further be discussed in chapter VI.

Customer Responsiveness Center is yet another quality-related organization which was set up recently. By its very name, it is clear that customer (be it internal or external) is the target to serve and to understand. It is the Company's another conscious effort to explore the customers' needs and their perceptions of the quality of products and services provided by the Company. The customer's response will then serve as the base for the Company to formulate future quality improvement programs and to achieve the goal of total customer satisfaction.

Communication

Communication is the essential software to ensure that all Motorolans recognize the Company's values and standards in quality, and how they are doing in meeting these standards. Communications can be in many facets: visual to written, formal to informal, or subtle to noticeable, but most important of all, it should be an ongoing process.

At Motorola-HK, communication of quality is pervasive and takes in various forms.

Visual

A stroll around the Silicon Harbour Center is the best way to understand how the Company uses visual elements to communicate its commitment to quality to its staff. The reception area is itself a good showroom for visual exhibits. First of all, the prominent banner with the Six Sigma logo hung against the wall catches the eyesight of everyone who steps in the Center. Then posters on Total Customer Satisfaction are put up at the receptionist table. The trophies awarded in recognition of the Company's quality achievement are put on display at the Center. Strolling around, one will find all along the corridors, posters, in particular on quality and speed, are abound. And against the wall in the conference rooms, plaques printed with a full version of the mission statement are hung.

However, to an outsider, it is the cheerful and well-mannered staff in the causal yet neat and tidy blue Motorolan uniform who are the best visual walking images showing the existence of a strong culture within the Company.

Nevertheless, to most Motorolans, the most important visual communication, perhaps, is the huge electric score board displayed in the canteen. The score board displays a summary chart of total process quality result. It is an effective visual communication in quality performance and output. By updating these charts on a regular basis, all Company achievements, problems and failures are communicated to all employees.

Written

The Company uses written communication regularly. The Motorola East, a full color, bilingual companywide newsletter, is published quarterly. Through it, all Motorolans are informed of the activities going on in the Company. Successful stories in quality and speed execution are unfolded and shared. Needless to say, staff members will receive, from time to time, circulars, notices, letters written and signed by the CEO reporting the progress of quality achievements. Staff members are also encouraged to use the Notice Board to express their opinion on quality and other Company matters.

Meetings

Whilst visual and written communication may be considered as a one-way communication which is best to create clarity and awareness in quality management, it is the face-to-face meeting which creates commitment and involvement. At Motorola, informal meetings and small group discussions are abound. These two-way communications are also most effective in enhancing understanding, teamwork and work improvement.

Other Symbolic Activities

Symbolic activities such as rituals and ceremonies are also vital in reinforcing the values and actions that relate to the quality culture. At Motorola, there are numerous occasions as such and we will highlight the annual quality week as an example.

Quality Week

The annual quality week is essentially an occasion to let all employees realize, through personal experience and participation, the Company's commitment to quality. It also helps enhance the commitment of individual employee, by signifying a mark for the progress in quality.

The Quality Week in 1993 took place from August 16th to 20th. The whole week's programs included Total Customer Satisfaction Showcase, the Vendor Day, a seminar on cross functional teamwork and also TV Quiz and game stalls.

The Total Customer Satisfaction Showcase was an experience sharing event in which six teams from Hong Kong, one from Taiwan, one from Korea and two from Singapore gathered to tell their success stories in the previous year. Whilst the Total Customer Satisfaction Showcase was targeted at the staff, the Vendor Day was aimed at bringing the vendors into Motorola's quality culture. On that day, fifteen suppliers were invited to participate and four were awarded the Supplier Award to recognize their outstanding achievement in the past. The cross functional teamwork seminar was yet another activity for the staff to recognize the importance and the success of teamwork.

Teamwork

Motorola emphasizes participative management in the outset:

> "There is a unique philosophy that allows each employee to contribute his or her insights to the achievement of the quality standards. This philosophy is translated into action through the Company's

Participative Management Program ("PMP") which brings work teams together to openly and effectively communicate ideas to help improve processes and products."

Thus, the Company creates and encourages the setting up of Work Improvement Teams ("WITs") which aim at encouraging individuals to take initiative to establish improvement goals for themselves and to formulate, recommend and, above all, to implement changes. The WITs are given the responsibility and autonomy to make work-related decisions. Supervisors are there to facilitate the process.

Through the team-building process, fellowship among the Company is established. More understanding among staff members and appreciation with each other's work is established. The end result is each will easily identify himself as a member of the extended family - the Motorola family.

In addition, members got a large amount of "emotional payoff" from such team-building approach. "It really gives you a reason to come to work, and want to be there. And get something done!".

In a lot of cases, the improvement goals were surpassed; cycle time was shortened, productivity was improved and quality is upgraded.

We will illustrate the works and achievements of some of the WITs in detail in Chapter VI and VII.

Training and Education

As put forward in the Quality Policy statement, Motorola aims at creating "a culture of empowerment for all in a participative, cooperative and creative workforce". By saying so, the Company has actually listed at least three criteria for its employees. First of all, they must have communication and computation skills. They must be able to do basic problem solving - not only as individuals but also as members of a team. Above all, they must be well-informed of the values and assumptions of the Company. And it is through training and education that can make all this occur.

The Motorola University

Motorola's commitment to training and education is evidenced by the establishment of the Motorola University. Statistically, in 1992, 107,000 employees participated in 450,000 days of training.

Motorola University Mission

> The mission of Motorola University is to be a major catalyst for change and continuous improvement in support of corporation's business objectives. We will provide for our clients the best value, leading edge training and education solutions and systems in order to be their preferred partner in developing a Best-in-Class work force.

The training materials generated by the Motorola University include the following:

• Brainstorming classes	-	to help develop and create ideas in problem solving
• Team-building	-	to help people function and work together more effectively
• Statistical process control tool	-	to collect and interpret quality data
• Cycle time reduction training		
• Process mapping training		
• The understanding of Six Sigma culture and its utilization		

The Orientation Program

For a new Motorolan at the Hong Kong site, training commences with the Orientation Program which is in fact the first drilling exercise to quality. It is a full day workshop in which the history and background of the Company together with the goals, concepts, and principles of quality are presented and discussed. A Company song in both English and Chinese lyrics will be taught to help boost the drilling process. An understanding of the mission statement will also be included. All the above give the Motorolan the first taste of its quality culture and provide a foundation for the remainder of the training.

The Manager of Managers Program ("MMI")

This is an intensive training program which curriculum is derived by the Motorola University with the objective to enable the managers to acquire the "3E".

The 3E stands for ENVISION, to set up a vision for future development; ENERGIZER, to arouse interest from the subordinates and lead them to achieve the goals and finally ENABLE, to dedicate authority to the subordinates and enable them to do the job themselves. In the two weeks' program, managers will be taught by instructors from the Motorola University as well as experienced outside consultants the tools to nurture new ideas, to deal with diversity and with crisis, to formulate strategy, etc. In Hong Kong, about two hundred managers have been trained in this program in the last two years.

Apart from the courses and programs supplied by the Company, each staff member is also encouraged to take courses run by outside academic and professional bodies as a means for further self development. They will receive financial support and sponsorship from the Company should their training proposal grant their supervisor's prior approval.

Motivation

Motivation is clearly of great significance to the success of the implementation of quality culture. The difference between an energetic, innovative and dedicated workforce and one who merely plods along doing the minimum in order to survive is often a matter of motivation. Individuals who are highly motivated are often able to work harder and more effectively and also to feel better about their work, their workplace and themselves.

At Motorola-HK, motivation is one of the major domains of the QuST which is under close and continuous review.

Job Security

Before the establishment of any tangible or intangible reward system, the Company has already satisfied their employees the physiological and safety needs in Maslow's Needs Hierarchy. They are the needs for the provision of basic living and job security. This is also a direct and positive response to Deming's "Drive out Fear".

In fact, the Company is in a way very similar to Japanese companies as life-time employment is practiced here in a subtle way and a great spirit of loyalty to the Company does exist.

Motorola has established a Motorola Service Club which membership consists of employees who have been working in the Company for at least ten years. Motorola values these long-term employees' contribution to the Company, thus, a member of the Service Club cannot be released from the Company without the consensus of the Chairman.

In Hong Kong where unemployment rate is low and job mobility is extremely volatile, Motorola HK still enjoys a relatively stable workforce. In fact, the executive management team, with the exception of one member, has been with the Company for ten to twenty-five years, a number which is relatively unusual here.

Rewards for Results

Quality management requires that achievement be recognized, both symbolically and in terms of material rewards. Motorola-HK knows this much better than other companies and they have developed a much elaborated reward system.

Coupled with the traditional bonuses system for outstanding achievement, the Company has also invented a few unique reward tools.

The most unique one for quality accomplishment is the monthly Shark's fin soup celebration if the Company as a whole meets the monthly quality goals. All the staff, from manufacturing to service, will join the celebration. As stated in the previous Communication section, the Company puts up a huge score-board at the canteen to enhance the awareness of its staff. Actual interim performance figures versus the monthly goals are displayed and updated every week. At the end of the month, if the goal is reached, the light box showing a bowl of shark's fin soup would be lit; if not, the light box displaying a sad face would light up.

The use of shark's fin soup as a means of reward is simple, straightforward and easily identified by all members of the staff. It is also most appropriate for Hong Kong people who, because of their Chinese culture heritage, pay a great emphasis on dining and drinking.

The "Small Win" is another unique means of recognition generated by the QuST. It is again simple and straightforward, without the need to go through formal bureaucratic procedures and files of documents and papers. The operation of "Small Win" will be elaborated in Chapter VI under the QuST.

Tangible rewards should also be linked with intangible rewards in order to motivate the staff members effectively. As stated in the previous Communication and Teamwork sections, staff members with outstanding performance and successful cases will be given the opportunity to come up to the center stage to receive awards and acknowledgments from the top management and appreciation and applause from colleagues. They will receive certificates or plaques with their names engraved and

their stories will be highlighted in the Company's newsletter "Motorola East". In short, they will be given a high degree of publicity.

CHAPTER VI

IMPLEMENTATION OF THE QUALITY MANAGEMENT

Having discussed the quality culture of Motorola, we can now turn our focus from a macro view to a more detailed mode to see how the management has utilized the various tools to actually implement the defined quality policy and achieve the stated quality goals. Just like the soil of a garden which lays the foundation for the plants to grow and flourish, a sound culture has the function of nourishing the quality system. The look of the garden would depend on what are planted there and how they are grown. In Motorola, the management decided to implement the Quality System by using the following tools.

Quality, Speed and Teamwork Program ("QuST")

In essence, the QuST program forms the building blocks of the Quality System in Motorola. When the management of the Asia Pacific Group recognized the importance of speed in addition to quality in 1991, the QuST was constituted to cultivate the culture of combining the two. The team was led by a Chairman together with four champions each of whom takes responsibility of one of the four major lines of businesses, viz. Administration; Manufacturing; VLSI Products and CPSTG & IC Products. These form the latitudes of the Quality System.

To cover each facet of a sound quality system, the Motorola Workshop devised the following eight domains:

1. Management Commitment & Style
2. Measurement Goal & Benchmarking
3. Communication, Promotion & Quality Week
4. Continuous Improvement through People Participation (Work Improvement Teams)
5. Education & Training
6. Recognition, Celebration & Employee Satisfaction
7. Responsiveness & Speed of Execution
8. Renewal (Review, Renew and Do it Again and Better)

The eight domains form the longitudes of the QuST structure. One representative is nominated from each of the four business lines for each domain to form a cross-functional matrix structure. This ensures comprehensive coverage and penetration across the whole organization. Leaders and sometimes co-leaders are appointed in each domain to facilitate communications and coordination. See the structure shown in Appendix 3.

Cross-reference between the QuST's eight domains and the famous Crosby's 14 steps reveals much resemblance:

QuST's 8 Domains		Crosby's 14 Steps	
1.	Management Commitment & Style	1.	Management Commitment
2.	Measurement Goal & Benchmarking	3. 10.	Quality Measurement Goal Setting

3.	Communication, Promotion & Quality Week	5. 9.	Quality Awareness Zero Defects Day
4.	Continuous Improvement through People Participation (Work Improvement Teams)		N/A
5.	Education & Training	8.	Employee Training
6.	Recognition, Celebration & Employee Satisfaction	12.	Recognition
7.	Responsiveness & Speed of Execution		N/A
8.	Renewal (Review, Renew and Do it Again and Better)	13. 14.	Quality Councils Do it Over Again

The Crosby's 14-step quality improvement program is known as a comprehensive, practical approach for implementing a quality management system and it is not surprising that it be used as the base for creating an up-to-date structure. Similarly, the QuST's eight domains can be considered as the tools to ensure effective and comprehensive implementation of total quality management. However, Crosby did not pay as much attention to two very important aspects of quality management which are much valued by Motorola - speed and people participation. The discrepancy between the two approaches on the "Speed" or "Time" aspect is not difficult to understand. In the olden days, quality and speed are two conflicting goals; achieving one is often at the expense of the other. However, with the advanced technologies and attitude change, quality and speed can be accomplished at the same time now. Motorola is the pioneer in the field which attaches equal importance to speed and quality and has devoted much time on cycle time reduction. They use

archery as an analogy to describe their task - without the speed, there is no way to reach the destination; and without the quality, there is no way to hit the target.

The other aspect, people participation, is one which deserves greater attention and is discussed below. A closely related domain is the "Recognition, Celebration & Employee Satisfaction" which plays a very important role in motivating the staff to participate in quality management. Other areas have been covered in the Chapter V on Quality Culture and we would not repeat ourselves here.

Continuous Improvement through People Participation

(Work Improvement Teams)

Crosby stressed that every portion of the organization must participate in the quality improvement effort, and also suggested training should reach all employees in order for them to actively carry out their role in the quality system. At Motorola, management addressed this same issue by encouraging team decision making. Any employee who notices a problem or an opportunity for improvement in workflow, method, system or any other work-related issues is encouraged to set up a Work Improvement Team ("WIT") to improve the situation. The idea of WIT was evolved from the concept of quality control circles first originated in Japan. This kind of participative decision-making systems is favored by many of America's best-managed firms because when employees participate in making changes, decisions are better understood and accepted.

Fundamentally, Work Improvement Teams are given the authority, responsibility and autonomy, supported by supervisors and technical personnel as required, to identify problems, to investigate and determine the cause(s) of the problem, to develop and test solutions, and to apply the successful solutions.

Some of the problems solved in this way may be of minor importance, but their aggregate effect is large. In addition, the cooperative environment and atmosphere brought about by the process result in increased sense of belonging and commitment.

When the concept of WIT was first introduced, it did require the management to kick-start and break the inertia. However, as it gains the momentum, the process has become part of the life of Motorolans and it is so natural for a new WIT to be born and an old one to retire after achieving the targets. As Mr. George Fisher put it: "Empowered organizations, teams and individuals are taking ownership of their positions and a personal interest in improving Motorola and its performance." In conclusion, WIT is proved to be a very effective, both in terms of cost and outcome, to achieve and sustain involvement of all employees in the battle of continuous quality improvement.

Recognition, Celebration & Employee Satisfaction

Leading thousands of employees in the pursuit of the company's quality goals is one of the most challenging roles of the managers, and motivating the staff to achieve preferred results is a crucial part of management. Motorola has a reputation in this aspect. The Company has its unique ways to motivate the employees to work to achieve Six Sigma (and beyond) in addition to the traditional methods of recognition such as raises, bonuses, promotions and commissions, etc.

One example is the Small Win Program which is well accepted by the employees. As mentioned in the previous chapter, managers are given the authority to present what are called "Small Win" coupons to whoever he/she thinks fit to express his/her recognition of the staff's efforts. The coupons, worth about HK$30, can be accumulated for redemption of exclusive souvenirs ranging from table clock to brief

case, most of which bear the Motorola logo. The "Recognition, Celebration & Employee Satisfaction" domain ensures that the range of gifts be changed occasionally to refresh the staff's interests. The success of Small Win Program can be attributed to its simplicity. It encourages the managers to show their appreciation as they have sole discretion on whom to be rewarded and do not have to justify their decisions by writing lengthy nominations/reports or appraisals. To the employees, the rewards are beyond the souvenirs redeemed as intangible merits such as publicity often come together with the Small Win coupons.

Implementation through Various Programs

The QuST Program can be considered as the operating system of a computer on which various application softwares can be run. Motorola-HK has numerous such individual software programs, some of which were developed in Hong Kong, and some were adopted from other Motorola locations. We have selected three of these programs for discussion here:

Six Steps to Six Sigma

"Six Steps to Six Sigma" is one of the few core training programs which each Motorolan must go through. The program teaches the techniques to analyze the causes for defects and then set improvement goals and work towards achieving such goals.

In short, the Six Steps to Six Sigma are:

Step 1: *Identify the product you create or the service you provide.*

In other words, the first step is to prompt every staff member to seriously think about what he or she is doing and identify the output that has room for improvement.

Step 2: *Identify the Customer(s) for your product or service, and determine what they consider important.*

This is the step to identify whom the staff is working for and what their critical requirements are. Here, the Company introduces to its staff the concept of internal customers. The employees are educated that although they may not deal directly with the customers, they must be serving somebody who does.

Step 3: *Identify your needs (to provide product/service so that it satisfies the Customer).*

The staff is asked to (i) scrutinize their own critical requirements for delivering the output defined in Steps 1 and 2 ; (ii) present the requirements to each supplier or source and (iii) reach agreement on how each requirement will be fulfilled.

Step 4: *Define the process for doing the work.*

In this step, the staff is asked to walk through the process that is used to create the product and then construct a process map or flow chart that shows how the work is currently done. This requires an analysis of each operation that makes up the process, the sequencing of the operations, the waiting time and storage points in the process, and, above all, a consolidation of the way mistaken work is done.

Step 5: *Mistake-proof the process and eliminate wasted effort.*

Based on the result of Step 4, the staff is taught to change the work process by refining and improving it. Improvement measures can be broadly categorized into two areas: those designed to lower the probability of producing defects and those designed to minimize cycle time, which in effect reduces the risk exposure to defects.

Elaborated methods introduced to employees with respect to the above two categories are summarized below:

Methods to lower the probability that errors will occur:

- simplifying key tasks
- increasing training specific to error opportunity points
- providing written instructions or other on-the-job aids
- standardizing procedures and formats
- instituting failure-free methodologies, which may sometimes require considerable brainstorming to devise

Methods to minimize cycle time:

- eliminating all non value-added activity, including unnecessary or redundant tasks and steps
- eliminating queues and storage
- finding ways to perform essential tasks more efficiently

Step 6: *Ensure continuous improvement by measuring, analyzing, and controlling the improved process.*

Various techniques such as Pareto diagrams, Cause and Effect (Fishbone) diagrams, etc. are introduced for analyzing the process.

Total Productive Maintenance ("TPM")

Total Productive Maintenance ("TPM") is a program targeting the manufacturing process of the Company. It is implemented at the working level aiming to achieve the following objectives:

1. avoid the production losses
2. enable better equipment utilization; and
3. perform preventive maintenance

Under TPM, the machine operators learn how to adjust the machines when something goes wrong and also to keep the production equipment in good working conditions so as to prevent the occurrence of defects

The "5S Club" is among the several functional teams which introduce to the staff the tools for achieving TPM. The "5S" concept was first developed in Japan the initial version of which comprises 5 Japanese words all starting with a "S", each represents a very concrete activity related to maintaining the physical plant. Motorola-Malaysia adopted the concept and further enhanced it to simple and easy-to-remember housekeeping rules for the workers to observe. They are:

Sort	-	categorize different tasks
Set	-	set the working area in a tidy way
Shine	-	polish and wipe clean the working area
Strict	-	take the 5S rules seriously

Standard - go through the standard checklist to ensure compliance to the housekeeping rules. Checking is performed by the next shift as the mutual control mechanism.

A "5S day" was organized in 1993 when cross-departmental housekeeping audits were performed to promote the awareness and compliance of the 5S rules.

Total Control Methodology

Total Control Methodology ("TCM") is a proprietary model developed by the Statistical Methods Engineering Department of Motorola-HK. A copy of the model is provided on Appendix 4.

The model suggests that with the various techniques to analyze and control variability, random changes can be eliminated and people would come to understand the work processes and then go on to control and improve them. Some of these techniques involve sophisticated statistical analysis models to be used by engineers, others are more effective to be employed on-line by the machine operators. The model gives the following examples as the driving forces for improvement which trigger the continuous improvement process:

- Feedbacks
- Failure Mode and Effect Analysis
- Machine/Process Capability Study
- Knowledge Fan-in
- Machine-to-machine Variation Study

Contributions by the off-line support staff, engineers and human resources/training personnel include:

- Calibration of measurement tools
- Gauge Capability Study to find out the Repeatability and Reproducibility Percentage of the machines
- Preventive Maintenance
- Performance Review; and
- Training

At a different level, on-line control of variation is accomplished by the operators by:

- Construction of:
  - a Positrol Plan
  - Process/Product Out-of-Control Action Plan
  - Setup Checklist
  - Control Charts & Positrol Log on Critical Factors
- Operator Dependent Control
- Auto Detection & Alarm
- Auto Detection & Correction
- Product Disposition

While the above are great tools and techniques proved to be effective in achieving target quality goals, it is important to point out that the key for a company to implement TQM is not having everyone learned how to use individual tools and techniques, but is the development of an integrated system of management and operations, which is what Motorola has been doing.

CHAPTER VII

SUCCESS STORIES SHARED

We have said enough about teamwork and should spend some time on one of its important elements - sharing, which is of paramount importance. The management does not encourage blaming anybody for doing wrong but definitely rewards and recognizes those who have done it right. There is well established channels for sharing experiences in Motorola. Every quarter, the QuST committee holds a Speed and Quality Excellence Sharing in an offsite location, most often a hotel, inviting about 10 WITs to share their success stories with others. Then there is the annual Asia Pacific Group TCS Showcase which is one of the programs in the annual Quality Week where the best stories shared in the quarterly gatherings are again presented. The two winners would then represent the Asia Pacific Group to participate in the Semiconductor Products Sector TCS Showcase in Phoenix, U.S..

Living up to their expectation, Motorola-HK is among the six companies in Hong Kong which received the award by the first Hong Kong Quality Circles Convention held last year.

The authors are very honored to be invited to attend the Speed & Quality Excellence Review for the fourth quarter of 1993 conducted at the Regal Riverside Hotel in Shatin. We are very delighted to have experienced the enthusiastic participation by the middle-lower level staff including production line operators and are amazed by the results achieved by the WITs. We have selected three of the twelve

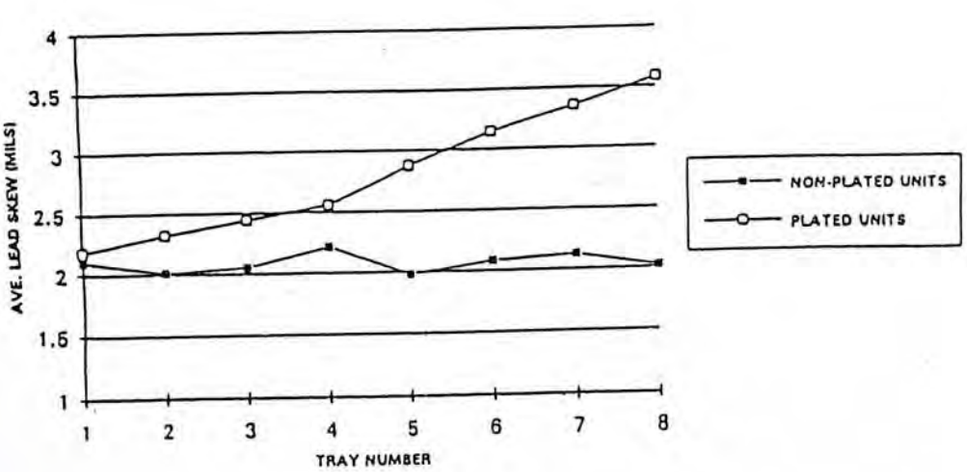
teams and give an excerpt of their cases below. As can be seen from the successful examples quoted here, the concept of WIT has been effectively employed and practised in both manufacturing and service areas.

Manufacturing Examples

1. Good-Shape Team

This is a typical case in which operational problems are identified and solved by staff at production lines.

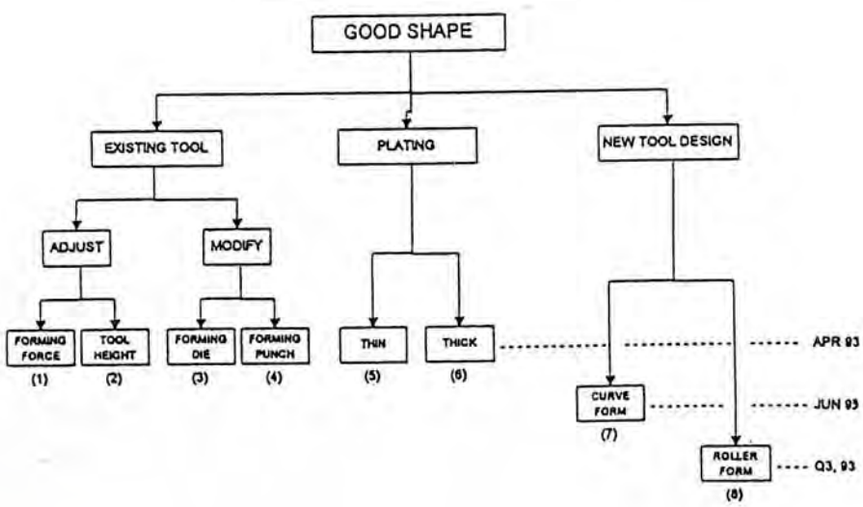
The team is formed by a number of operators who are responsible for forming the bent legs of the semiconductor chips. Solder built up on the die surface must be removed or it would hinder the forming of a standard bent leg. Production statistics show that the average number of scrap items would increase to beyond an undesirable level after production of about 120 units. See the graph below:



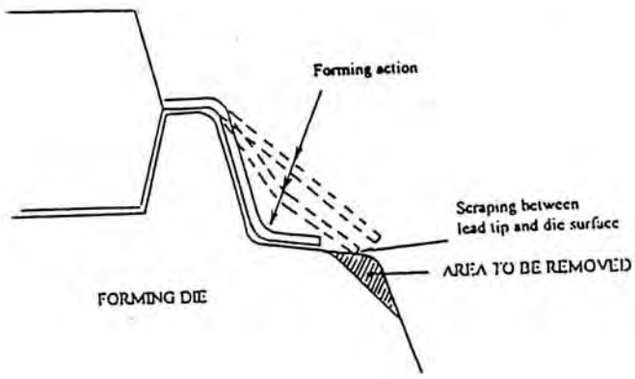
Encouraged by the Company to take initiatives in solving their own work problems, the operators seek positive ways to get a breakthrough. The team knew that frequent tool cleaning is the main detriment to the reduction of cycle time as it takes up more than 75% of the working hours. Therefore, by eliminating the cleaning step could theoretically enhance the manufacturing capacity by four times.

After reviewing the situation, the team decided to achieve the target of four-fold capacity in three phases, in terms of time and immediateness. The first one was focused on adjusting and modifying the existing tools in various ways hoping to find a fast and easy solution. Should Phase One fail, the team would then look beyond the die and punch process itself and go one step backward to explore any room for improvement during the plating stage. If the discoveries in the first two phases warranted the design of new tools, then Phase Three would be brought into picture to achieve the goal. Each phase is discussed in turn below;

PROBLEM SOLVING ROAD MAP



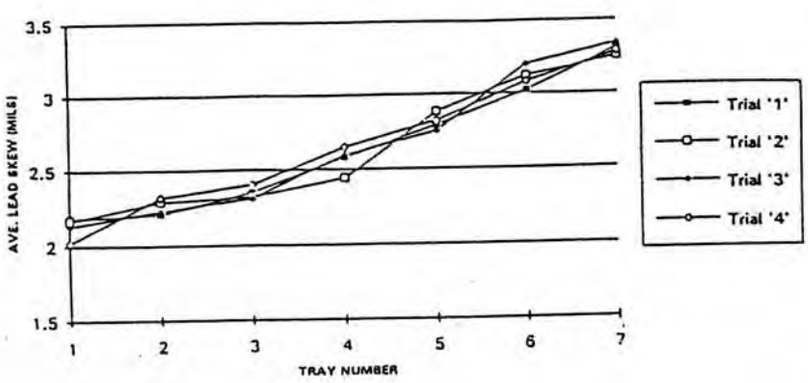
After reviewing the existing method, the team realized the cause of the solder built-up. During the forming action, the lead tip of the chip would scrape against the surface of the die and thus scratch off some plating materials.



The first effort was to test whether the forming forces used and the tool height had any bearings with the outcome. The graph below confirmed a negative answer.

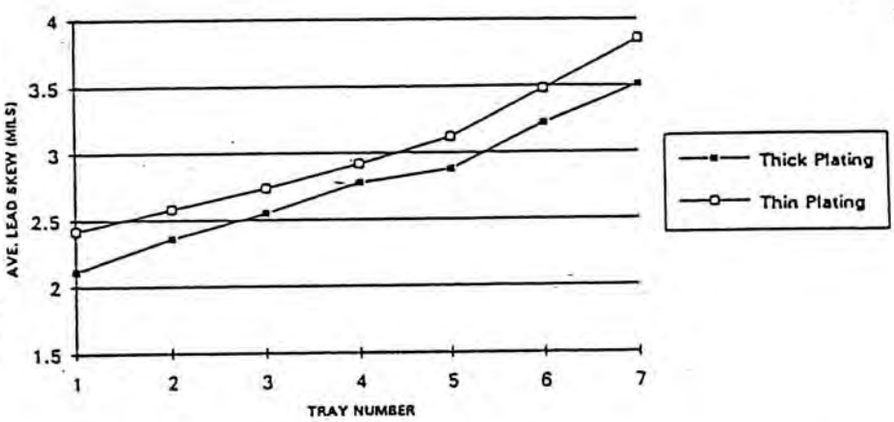
FORMING FORCE AND TOOL HEIGHT

	Forming Force	Tool Height
Trial '1'	High	Low
Trial '2'	High	High
Trial '3'	Low	Low
Trial '4'	Low	High

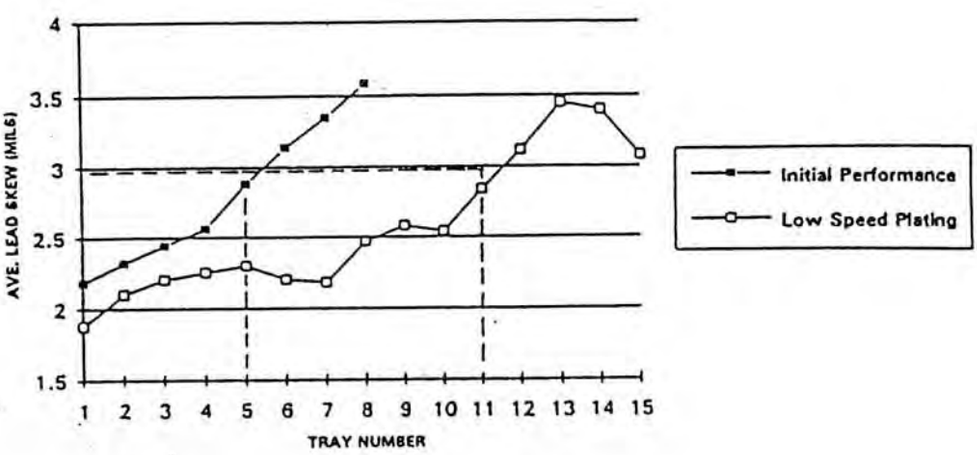


When the team tried to modify the die and the forming punch, they also found that they were not the vital sources of the problem.

Without any delay, the team marched into Phase Two and experimented the relationship between thickness of the plating and the solder built up. Some interesting results showed up (see graph below).

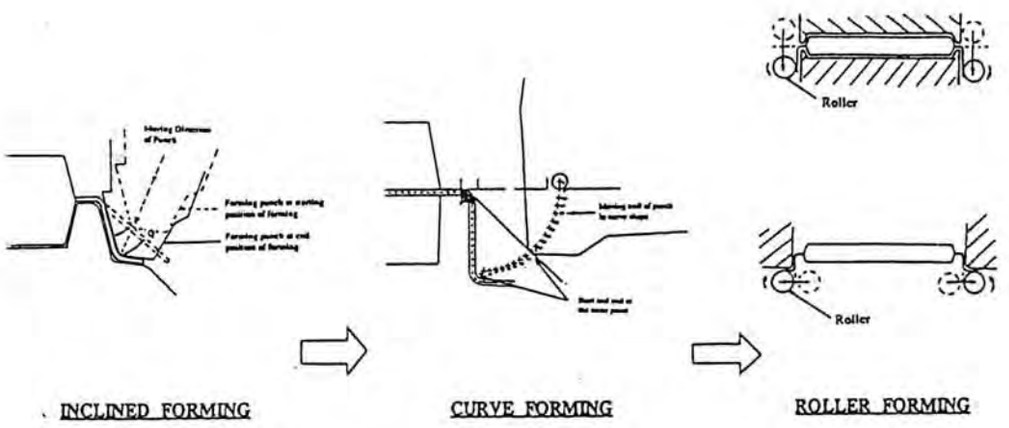


Repetitive performance of same test eventually revealed that the difference in performance was attributed to the speed and NOT the thickness of plating.

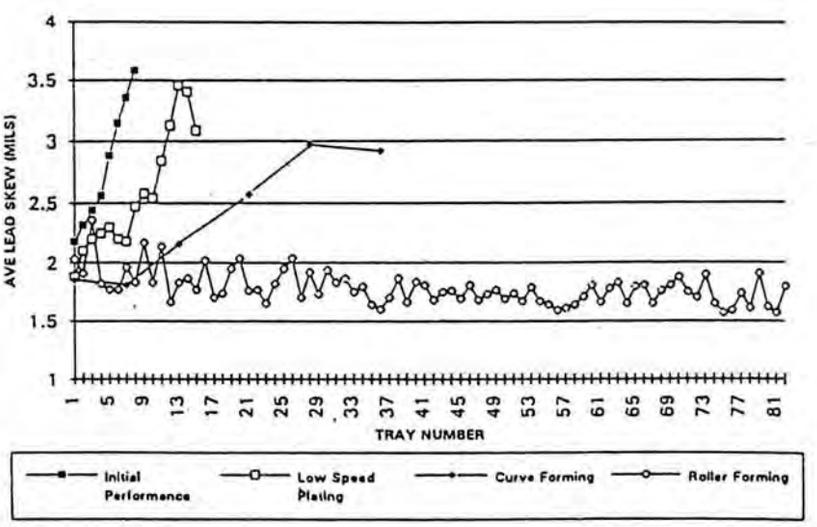


This is an important discovery and gives valuable clues in designing the new tools. The team therefore endeavored to search for a forming

mechanism which does not call for an attached or fixed contact point between the lead and the forming punch. Curve forming and roller forming are two such options and experiments showed that the latter is more superior in preventing solder built up.



In fact, the roller forming mechanism has basically eliminated the solder built-up problem. The average number of lead skew is well below the specification as can be seen from the following diagram.



The workers do not have to spend as much time to clean the tools. As expected, the capacity has been significantly increased in half a year's time.

The achievements are summarized in the table that follows which enabled 50% reduction in manpower:

	Before	After
Production Capacity	20,000 per week	>100,000 per week
Tool Cleaning Frequency	120 units	>3,000 units

2. S-Mark Team

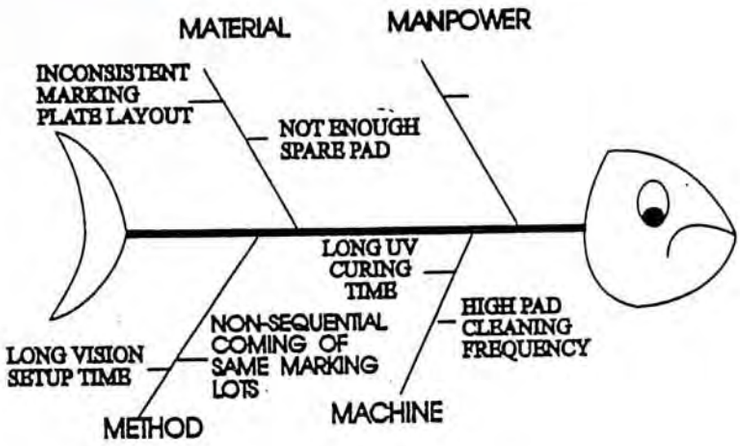
The formation of the S-Mark Team was triggered by an unexpected delay in the delivery of a new machinery ordered, which is much needed to cope with the increasing output demand:

S-MARK TEAM

Background

- The loading demand of 10x10 QFP would be 1,050K per week in October
- The AIS laser marker cannot arrive on time in September
- The maximum capacity in marking process was only 650K per week in July
- The marking process became the bottleneck of production

To analyze the various factors affecting the productivity of the Marking System, the team created a Fish Bone diagram as follows:

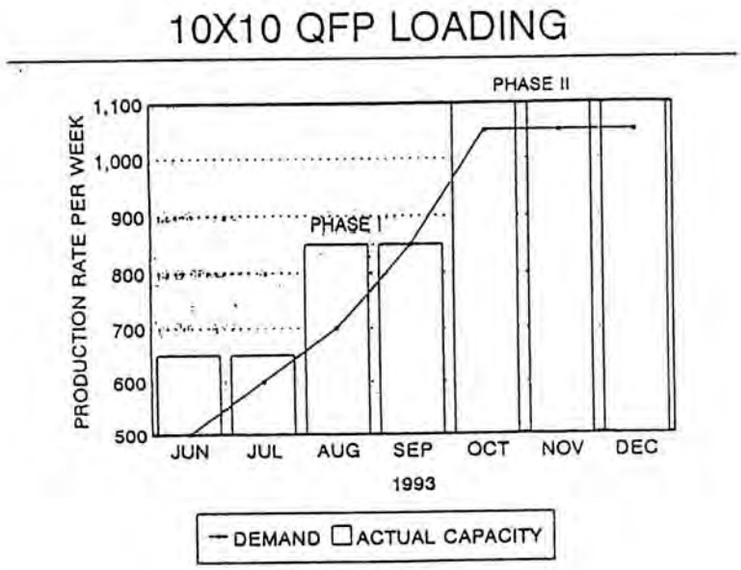


The various problems identified were then individually rectified accordingly:

PHASE I CORRECTIVE ACTIONS		
Factor	**Action**	**Responsible Party**
1. Long UV curing time	reduce the marking system cycle time from 7 seconds to 6 seconds	• Process Engineering • Equipment Engineering
2. High pad cleaning frequency	reduce the pad cleaning frequency from every 10 strips to every 20 strips	E.M. Team
3. Not enough spare pad	enhance pad p.m. frequency and reduce pad life cycle from 14 days to 10 days	T.A. Team
4. Inconsistent marking plate layout	re-format the marking plate layout setting in the darkroom	Process Engineering
5. Long vision setup time	standardize the vision setup procedure	Process Engineering
6. Non-sequential coming of same marking lots	gathering the same marking lots before marking process	Supervisors and Leaders

With the above piece-meals improvements, the capacity was successfully increased from 650K per week to 850K per week i.e. increased by 30% to meet the interim demand in September.

However, the above are emergency measures the efficiency of which have not been stretched to the fullest extent possible. Phase II is intended to invent better ways by tackling the root cause of the problem which was distinguished to be the UV dryer in use. It was modified by the E.M. team to deliver a more powerful output which enables the reduction of marking system cycle time from 6 seconds to 4 seconds. Accordingly, the capacity was raised from 850K per week to 1,100K per week, i.e. increased by 29%.



This story may not be as exciting as others but demonstrated the power of cooperative forces. In five months' time, the total capacity was increased by 70% even without any new capital investment. In an environment where everyone is striving for the goal of total customer satisfaction, empowered employees would not be easily discouraged by the obstacles in their way, such as the late delivery of machines or supplies as in this example, and positively seek for other means to reach the same ends.

Non-manufacturing Examples

1. Acting System

In a sizable company like Motorola, there are many long-standing habits or practices which warrant a change but everybody may just accept them as "traditions" without questioning. However if somebody cares to think about them and takes action to improve them, it may not be difficult to find a better way which can lead to big savings and better efficiency. The following is one such example:

At Motorola, there are hundreds of managers all of whom would occasionally need back-up managers to "act" for in their absence due to various reasons such as vacation, business trips, training, etc. Traditionally, the manager going away would type an acting notice, copies of which are distributed to all other managers. This practice not only consumed a lot of papers but also proved to be ineffective. It requires extra effort on the part of the recipients to file these notices or the papers would got misplaced or buried away in the in-tray.

The Acting System Team, which comprised people from different disciplines, saw this drawback and took initiative to seek a better alternative. They interviewed the users and obtained their requirements of the ultimate system and have accordingly devised a user-friendly new computer program to perform the function.

Now the manager going away just need to open an electronic record in the Acting System database giving all the details before he or she leaves. And the users, when required, can access the Acting System database where all information is presented in a systematic fashion at a glance.

The achievements are summarized below:

- Information on acting managers is now centralized to reduce cycle time and manual work.
- Systematic procedure in preparing acting notice.
- The new Acting System is also interfaced with other systems e.g. payroll system, for consistency and improved efficiency.

2. Corporate Audit Group

Let us now look at a celebrated report which is reproduced in the Company's newsletters and also in-house training materials of the Company.

It is about a corporate support function, The Corporate Audit Group, which has received the CEO Quality award in 1990 as recognition for its meeting the challenge of Six Sigma quality.

The whole process began intensively in 1985 when the Company started to grow rapidly following significant changes. For the Corporate Audit staff, it meant more demands for internal controls, compliance to standards, and audits. At that time, it was taking more than 50 days to produce an audit report, once the audit fieldwork was completed. Audit scheduling was done sporadically with only half the annual audit plan being completed each year.

Audit workpapers and the final audit reports were prepared manually. At any one time, five department secretaries would have stacks of folders of audit reports awaiting typing or edits.

The Group realized that its complement of people was not likely to grow in proportion to the increasing demand of its services. They also realized that accurate, timely and meaningful audit information would be essential in keeping the company on track. This was clearly going to require a change in the Group.

Luckily, through their audit process, they saw what was going on in the production areas with quality control measurements and conceived that Corporate Audit would need to be measured in the same way.

During 1985 and 1986, they began to measure activities performed by the department. They used the "Participative Management Program" process to set goals to reduce the cycle time for preparation and distribution of reports. Staff members found ways to cut unnecessary procedural steps and automate report preparation.

Some of the opportunities for error in an audit process are apparent, such as not finding existing control problems during the audit process or not properly stating facts in the audit report. But there are other potential defects.

During October 1987, a small group spent weeks identifying how to measure the critical processes for a crisp, clean audit process. Under the supervision of the senior audit manager, they considered all the processes they used and determined which had the highest impact on their mission. The

conclusion is that audit fieldwork and reporting represented the most significant opportunity for improvement.

Beyond process improvements is the real significance of the group's work. They focused on doing the job right the first time, every time. For all their efforts, the Corporate Audit Group has realized a twelve-fold improvement in cycle time of audit reports in 4 years. The audit reports which used to require 50 days are completed in 5 days. There has been a three times improvement in the cycle time of staff performance evaluations, a two times improvement in the time required to complete the domestic external audit, and a reduction in the defect rate on audits from 10,000 parts per million to 400 parts per million. These have resulted in saving US$2.6 million.

As they put it, "they now have the process and tools to achieve the expected output and feel that there are no reasons for each audit not be Six Sigma."

CHAPTER VIII

MOTOROLA CORPORATE QUALITY SYSTEM REVIEW

Introduction

Having reviewed the culture and numerous efforts to implement various quality programs or exercises, it is important to ensure that everything be done in a concerted and coordinated fashion so as to achieve the highest efficiency and effectiveness possible. This, put it another way, is the construction of a comprehensive and complete Quality System to ensure the sound practicing of quality management.

Indeed, one common problem of nonsystematic approaches to quality management is their failure to recognize the interrelatedness of all activities. Many companies try to apply standalone management practices, some of which have been proven sound and successful in other companies, while neglecting other considerations and become discouraged when no miracles happen. This is also the case in the early stages of Motorola's development of quality management. Fortunately, the management sustained their continual effort to strive for improvement of the system and has eventually made their way through the obstacles.

The collaborative or "system" approach to achieving quality was first expounded by Dr. A.V. Feigenbaum in his book "Total Quality Control" (McGraw-Hill, 1961) which is one of most prominent references in the field. The Quality

System is defined as "The collective plans, activities and events that are provided to ensure that products, processes and services will satisfy given customer needs."

Following the awakening of the importance to quality management are the increasing concerns on how to measure the effectiveness of the quality system implemented. Consequently, this has led to the development of quality system standards and guidelines. One of the most widely adopted standards in this part of the world is the International Standards 9000 series (ISO9000 to ISO 9004 inclusive) by the International Organization for Standardization ("ISO"). All companies bidding for Hong Kong government contracts are required to have obtained the relevant ISO9000 certificate. Back in the 1970s, The American National Standards Institute Z-1 Committee on Quality Assurance has also developed three documents that apply to quality systems:

1. ANSI/ASQC A1-1978, Definitions, Symbols, Formulas and Tables for Control Charts
2. ANSI/ASQC A3-1978, Quality Systems Terminology (A3)
3. ANSI Z1.15-1979, Generic Guidelines for Quality Systems

Motorola-HK was granted the ISO9002 certificate in May 1993 and 50 Motorola offices worldwide have completed the certification process by the end of 1993.

Motorolans have their own philosophy. The Management of Motorola has used an analogy to describe their attitude towards ISO9000 certification. The ISO9000 certificate, analogous to a driving license which gives one the legitimate right to drive on the road, confirms the external recognition (& endorsement) of the Company's quality standards. It means that the applicant has attained the international standards which are however bound to be a general one. For Motorola, a high technology company, precision is extremely important and a more demanding system

is needed to cope with the rapid pace of technology development. Their products may be used in the laser surgical machines or space shuttle where a minor deviation from specification may be fatal. The Company believes that a driving license is not enough to guarantee safety driving and has therefore developed for themselves a set of more meticulous and detailed review procedures and guidelines to assess the effectiveness of their quality system. This chapter is devoted to the examination of this proprietary process of theirs (which is known as the Quality System Review ("QSR")) and the comparison between the QSR guidelines and the ISO9000 standards.

The Quality System Review

Before going into the details, we provide below a brief introduction of the main features of the exclusive assessment tool of Motorola and the scope of its application.

Background

To assure that the Quality System of each business of the Company is effective in achieving Total Customer Satisfaction, the Motorola Corporate Quality Council ("MCQC") began in 1982 a process of biennial Quality System Reviews ("QSRs") to assess the system maturity of each Division or Group in the Company. The process did not only evaluate the ongoing health of the Quality System but also point out strengths and opportunities for improvement, very much like the internal audits undertaken by most major companies.

In 1988, a modification of the internal QSR was established for surveying the Quality System of Motorola suppliers. Since then, there have been separate programs for internal Motorola self audits and external supplier assessments until the initial

version of QSR Guidelines was published in 1991 which was revised in November 1992.

There is reason that the Motorolans consider their QSR be more comprehensive than the ISO9000 qualification because a committee made up of MCQC members from Europe worked to incorporate the elements and requirements of the ISO9000 to the fullest extent possible into the QSR Guidelines. A cross-reference guide between the QSR and ISO9001 is provided as Appendix 5 at the end of this paper. It can be seen that all the requirements of the ISO9001 are covered by the QSR while the reverse is not true.

The QSR Guidelines is built on the framework of the quality system promulgated by Frank Caplan. This alliance is not incidental as Caplan has acknowledged the contribution of Roger L. Lohn of Motorola in the preface of his book "The Quality System - A Sourcebook for Managers and Engineers". In addition, to allow for ease and consistency of scoring, a maturity matrix is patterned from the Malcolm Baldrige National Quality Award scoring guidelines. The matrix is provided as a general assessment tool against which to measure achievement levels for all elements of the QSR. A copy of the QSR General Scoring Maturity Matrix is reprinted as Appendix 6.

The Purpose

It is stated in the Guidelines that the purpose of the QSR is to

> "...evaluate the continuing health of the Quality System in each major Motorola business unit or Motorola supplier. **It defines a vision of how our business should be conducted, it sets a common goal of perfection** and provides an

awareness of Quality System requirements across the total organization. These reviews also provide opportunity for **cross-fertilization of ideas and serve to routinely refocus the organization on Quality**. Using the formally documented QSR assessment form and review procedures, the review team is able to reflect a macro view of the subject business unit/supplier, recognize achievements, **point out shortcomings and opportunities and offer recommendations for continuous improvement** ..."

The Timing and Frequency

Internal QSRs are conducted on a biennial basis by a cross functional review team of four to five senior management experts from diverse parts of the Company. A typical internal QSR usually spans one week whereas a supplier QSR is conducted over two to three days by a team of two to five individuals. The team leader must be a member of the MCQC and has previously served as a term member on at least one QSR team.

Supplier QSRs are utilized for sourcing decisions, problem solving and benchmarking. The timing and frequency depends on a number of factors including new technology, supplier quality history, product risk and process stability.

The Process

The review team interviews a cross section of the subject business using a series of quality elements which are categorized into ten subsystems. A list of the elements in each of the ten subsystems is attached as Appendix 7. Each subsystem element is elucidated by a set of "Considerations" which helps explain the element

through clarification, examples or expansions for enhancing consistency of interpretation.

A set of scoring guidelines is also provided to help the review team to score the result of the interview in term of integers ranging from "0" (Poor) to "10" (Outstanding). The individual scores of each element combined with its applicability in the subject business, are summarized into a total QSR score and "Strengths", "Opportunities for Improvement" for the business unit. Scores less than "7.1" (Qualified) require a corrective action response by operational management.

It is mandatory that the preliminary QSR meeting and the wrap-up meeting must include the top officer of the subject business unit, who has the responsibility to implement any necessary changes. (For supplier QSR, a set of QSR documentation is provided to the supplier prior to conducting the review so that the supplier can conduct a self audit first.)

Some Thoughts on the QSR

A copy each of the Evaluation Work Sheet for one of the ten subsystems and the QSR Review Report is shown on the following two pages. Arithmetically, both are used to work out a summary rating. The way to do it is by taking the average of the product of multiplying the individual rating by an applicability factor or weight. The applicability factor/weight therefore has a direct bearing on the final score.

The applicability factor for each element within every subsystem is filled out by the business unit management team to reflect its relative importance for the business (although they can be questioned if the review team feels that they were not properly interpreted).

On the other hand, the weight for each subsystem has been fixed and pre-printed on the QSR Review Report. This gives a clue as to the key values of Motorola. In this direction, we would discuss three of the subsystems in turn below.

Subsystem 1 - Quality System Management

Subsystem One concerns the ongoing management of the entire quality system, ensuring its continued applicability and effectiveness.

As Motorola believes that Quality Systems must be integrated into a business unit from the top most level down, it is not surprising that this subsystem has a weight of 15%, the second heaviest.

Looking at this subsystem in greater details reveals that there are three elements which do not have matching counterparts in the ISO9000 standards. They are reprinted below:

"1.4 Are benchmark and customer satisfaction studies done to determine best-in-class for all products, services and administrative functions, and are goals set so that quality is a competitive weapon?

1.10 Does management attach equal importance to administrative quality systems as to product/service quality systems?

1.11 To what extent does management solicit, accept and reward feedback from the work force?"

Reinforced by the key goals of the Company to become the best in class on various areas, Motorola treats the competitive benchmarking and customer satisfaction studies very seriously. As can be seen from the element description itself, the Company does not merely take Quality as a means for survival, but rather a **competitive weapon** if used properly. The management has noticed that attaining or even exceeding internal goals and standards are no guarantee of customer satisfaction as the customers may have totally different perspective or perception from the Company. In fact, Motorola dedicates a whole separate subsystem on the Customer Satisfaction Assessment, which will be discussed below.

Albeit being a manufacturing company, Motorola has not neglected the administrative functions such as Engineering, Design, Facilities, Finance, Personnel, Order Entry, etc. The management has clearly attached equal importance to administrative quality as it does to product/service quality.

Benchmark studies are also performed for non-production areas to determine the best-in-class methods and practices and the results are used to define improvement goals and action plans. One classic example is the story of auditing department described in Chapter 6 and there are more: Month-end closing in the Accounting Department is a big job and used to take seven days to complete. The time length has been significantly reduced to just one day in the third quarter of 1990. There are still continuous and self-initiative effort by the Accounting staff to further shorten the time required.

All employees in the administrative functions are also sent to core quality training programs such as Six Sigma. The "1.11" element shows the Company's value on participative behavior of its staff. It reminds the management to empower the employees to take initiative in making quality improvements, and to show support and

encouragement for such. To this end, it reinforces the our discussions below that the Human Resources Involvement should be better rated.

Subsystem 8 - Human Resources Involvement

Surprisingly, "Human Resources Involvement" is among the three subsystems which are assigned the lightest weight, 5 percent. The other two are "Quality Data Programs" and "Control of Quality Measurement Equipment and Systems" respectively.

The subsystem on "Human Resources Involvement" addresses the need to obtain full commitment from all personnel to doing all the things necessary to achieve the Company's quality objectives. The elements within this subsystem cover areas such as training, performance standards and reward/incentive etc. The human factor is unarguably one of the most important ingredients to an effective Quality System without which the system would bound to be a static one. The fact that this subsystem is accorded a 5 percent weighting is not quite in line with what the Company has set as one of the key initiatives - participative management. In fact, Motorola has spent tremendous effort to promote the importance of every individual employee's contribution to the achievement of Total Customer Satisfaction and the overall success of the Company. One of the evidence of the Company's emphasis on total staff involvement is that all operations is shut down to allow the staff to attend the opening ceremony of the Quality Week.

Subsystem 9 - Customer Satisfaction Assessment

It has been mentioned more than once in precedent chapters that Motorola has set "Total Customer Satisfaction" as its fundamental objective. Using their exact wordings: "Total Customer Satisfaction is the overriding responsibility of everyone in

the company, and the focus of all of our efforts". With this background, it is not difficult to understand why the Subsystem Nine on Customer Satisfaction Assessment receives the heaviest weight of 20% among the ten subsystems.

Interesting enough, more than half of the elements in this most important subsystem is not covered by ISO9001, they are:

"9.1. Is there a measurement system in place to effectively assess the customer's perception of our complete performance?

9.2. Is an independent (unbiased) competitive image survey routinely conducted?

9.3. Is there an internal measurement system within the organization which correlates to the level of customer satisfaction?

9.4. Are there specific goals for achieving Total Customer Satisfaction, both internal and external?

9.5 To what extent are customer satisfaction goals disseminated and clearly understood by everyone in the organization?"

Understanding that the customers may have different perception on the company's quality performance, Motorola utilizes various methods to obtain inputs from its customers. Some examples are questionnaires delivered with the products and client surveys etc. The Company also uses all of its executive officers, including the Chairman, CEO and others, from both the corporate and sector/group levels to go out and listen to the "voice of the customers". During these meetings, customers are made to feel at ease in discussing any area of the business relationship, be it product

or service. The results of these interfaces are brought back, analyzed and disseminated throughout all of the corporation. Results are reviewed at Corporate Operating Committee meetings and follow-up customer meetings continue until issues are resolved. There is however a drawback in this assessment technique. It is because Motorola is a big name and the senior management visit itself generates a "They really do care!" response. This has already influenced the response from the customer. It is good to demonstrate the Company's eagerness to improve quality in products/services but may not be as effective to collect the genuine concerns from the customers. This is especially the case in the Orient where the culture generally calls for a "non-confronting" behavior. Even if there is anything not up to their expectation and standards, the Asian managers may choose not to speak out explicitly when meeting face to face with their suppliers.

The TCS 100 - Customer Satisfaction Workshop is formulated as one of the core training programs which is for all employees. The training does not only preach the importance of customer satisfaction, it also helps the staff (especially those who do not have direct customer contacts) to identify and visualize their link with the customers. Every Motorolan serves the customer: if one does not serve the customer directly, he or she probably serves some others who do - the concept of internal customer.

CHAPTER IX

CONCLUSION

Motorola has travelled a substantial mileage in its pursuit of quality improvement. Today, quality has been institutionalized and integrated into the Company. It has also become a powerful weapon for the Company's competitive edge and has enabled the Company to achieve outstanding results. The Company's latest Annual Report shows that in 1993 it enjoys, for the first time, a net profits in excess of US$1 billion and its Semiconductor sector has now overtaken some major Japanese companies and become the third largest producer in the world.

As what the Board of Directors has reiterated in the Annual Report, Motorola is "a company with a distinctive culture that incorporates an obsession with quality, uncompromising ethics and respect for people. These values create the foundation for our success."

Indeed, in the course of our project while we retraced the development of quality management in Motorola, we do share that such distinctive culture provides the building block for its success with the provisions of various quality management tools and the Quality System Review being the practical enhancement for its quality implementation.

Quality culture has been deliberately cultivated within the Company with an elaboration of the following components:

- mission, vision, shared values and assumptions
- top management's commitment
- organization
- communication
- teamwork
- training and education
- motivation

"Rome cannot be built in one day." Our study also shows that such cultural transformation cannot be attained without several years of daily practice and continuous improvement of the whole system. Motorola has gone through these stages and its quality dynamics have been set in motion. Nevertheless, there is still the need to continue to explore the road ahead, to avoid staying stagnant on the one hand and to prepare for future challenges on the other. The top management in Motorola-HK is well-aware of it and has already touched up its vision.

During our concluding interview, Mr C.D. Tam revealed that they are restructuring the QuST and rename it to QuST^2 ie Quality, Speed, Teamwork and TECHNOLOGY. Another new element, Technology, is now introduced. The Company is ready to "DO IT OVER AGAIN". It is a visionary reaction in face of future quality needs. It also demonstrates the top management's enduring efforts in striving for continuous improvement.

Quality management is a never ending process. It continues far beyond the horizon we are able to visualize. Therefore, ultimately, it should be this spirit of "DO IT OVER AGAIN" which propels the Company forward to meet future challenges facing quality management.

BIBLIOGRAPHY

Background Materials supplied by Mr. C.D. Tam (extracted from various magazines)

Frank Caplan, The Quality System - A Sourcebook for Managers and Engineers

Hampden Turner Charles, Corporate Culture for Competitive Edge: a User's Guide, The Economist Publications, 1990

Philip B. Crosby, Quality is Free: The Art of Making Quality, McGraw-Hill Book Company, 1979

Robert W. Galvin, Statement on Motorola's Quality Experience, Motorola Inc., 1988

Max Hand and Brian Plowman, Quality Management Handbook, Butterworth-Heinemann Ltd, 1992

ISO 9000 series. British Standards Institution

Motorola Corporate Quality System Review Guidelines, November 1992

Motorola Quality Symposium, Communicating the Quality Message, Motorola University, 1993

Marshall Sashkin & Kenneth J. Kiser, Putting Total Quality Management to Work, Berrett-Koehler Publishers, 1991

A. Richard Shores, A TQM Approach to Achieving Manufacturing Excellence, Quality Press, 1990

Davis M. Stanley, Managing Corporate Culture, Ballinger Publishing Company

C.D. Tam, Hi-technology Multi-national company investment in Hong Kong - A Case Study of Motorola, 1983

Roger Tunks, Fast Track to Quality: a 12-month Program for Small to Mid-sized Business, McGraw-Hill, 1992

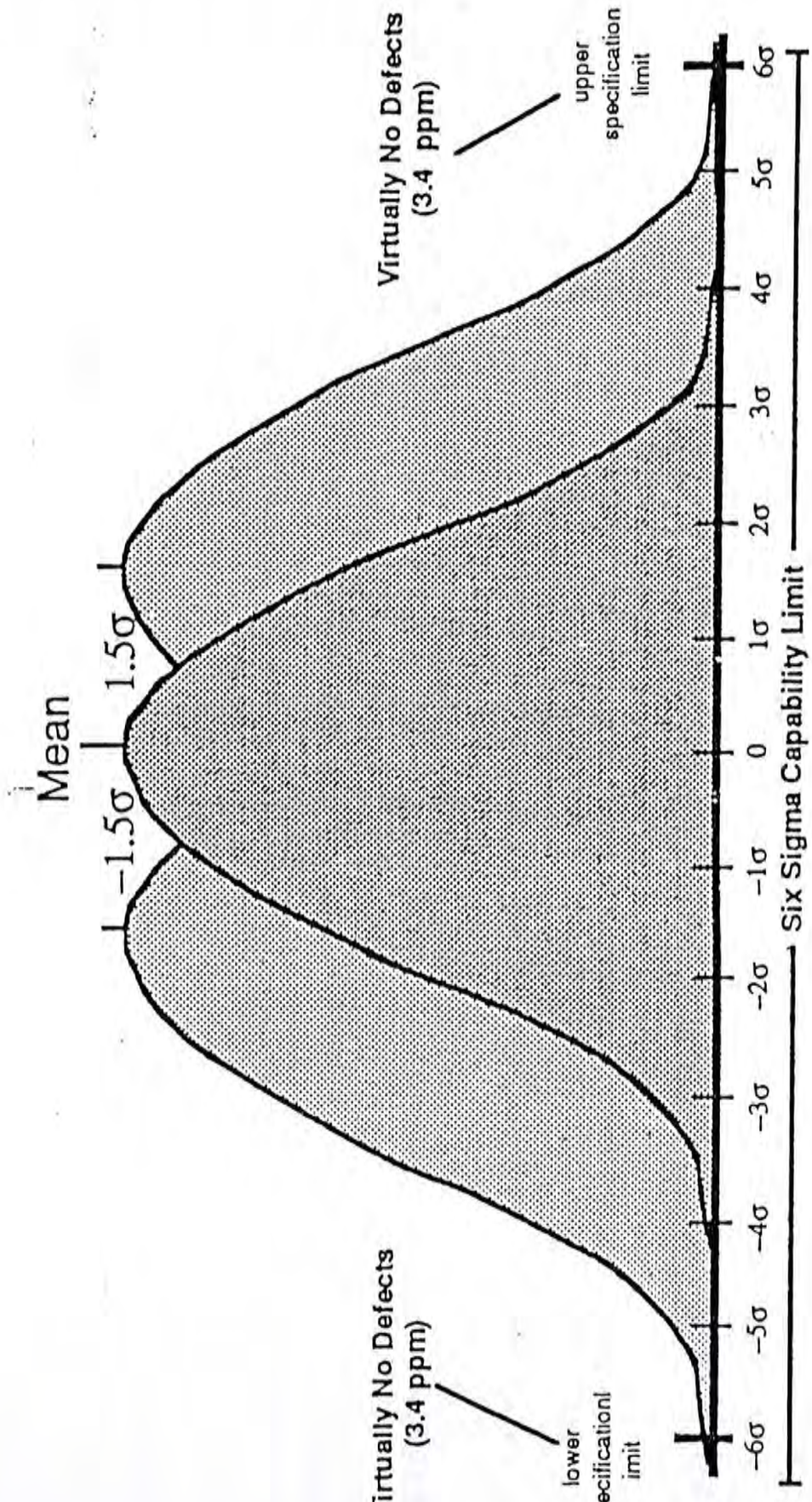
William Weisz, What is Six Sigma?, June 1987

Robert Westwood, Organizational Behaviour: Southeast Asia Perspectives, 1992

William Wiggenhorn, Motorola U: When Training Becomes an Education, Harvard Business Review, July - August 1990, Reprint No. 90413.

Robert K. Yin, Case Study Research - Applied Social Research Methods Series Volume 5, Sage Publications, 1989

Amatulli & Associates, Leaders in Quality (videorecording), Goal / QPC, 1991


Mean
−1.5σ
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Virtually No Defects
(3.4 ppm)
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specification
limit
Virtually No Defects
(3.4 ppm)
lower
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−5σ
−4σ
−3σ
−2σ
−1σ
0
1σ
2σ
3σ
4σ
5σ
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Six Sigma Capability Limit

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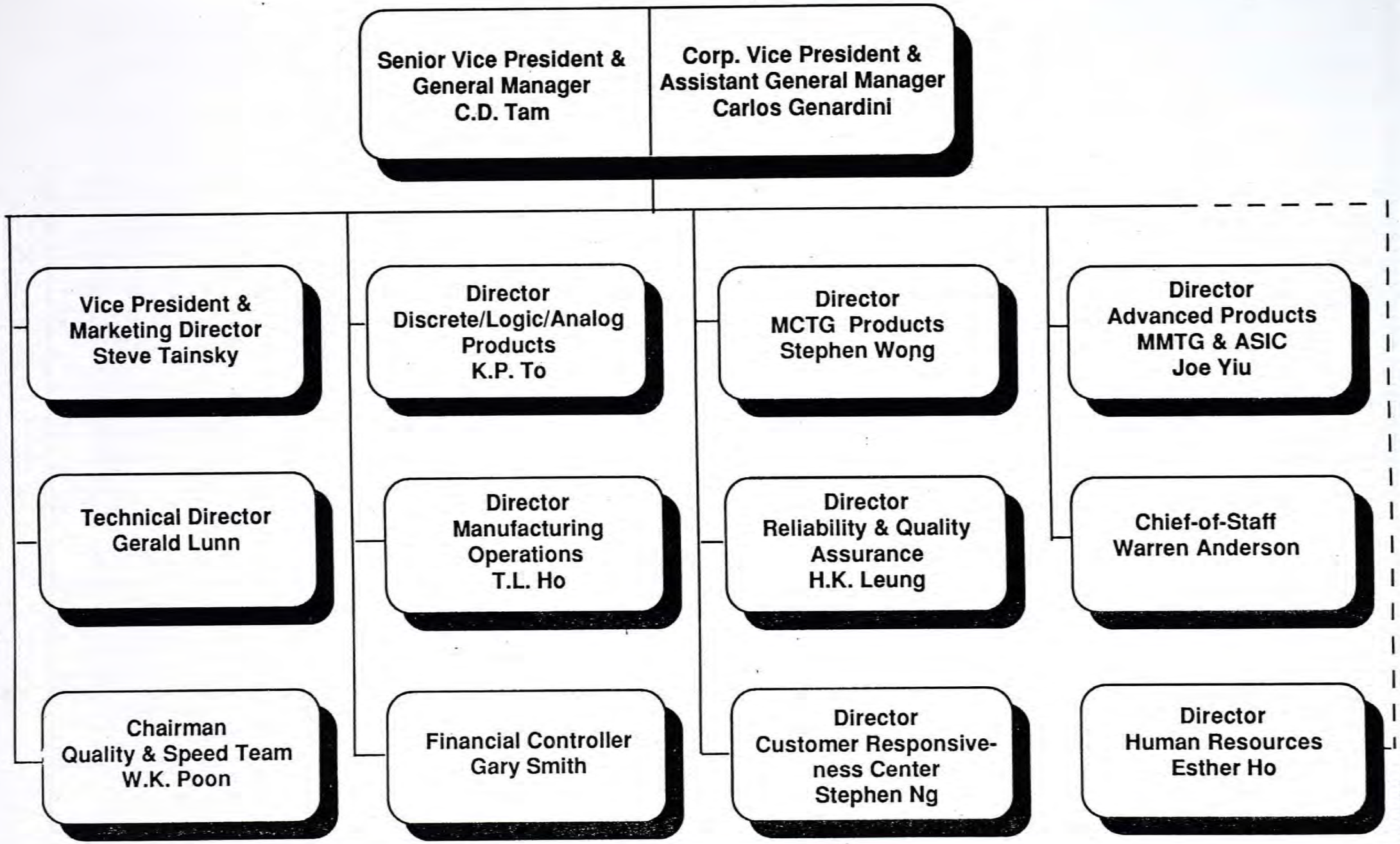

Appendix 2

		ADMINISTRATION QuST	MANUFACTURING QuST	VLSI PRODUCTS QuST	CPSTG & IC PRODUCTS QuST
	CHAMPIONS	*WARREN ANDERSON*	*EDMUND LAW*	*STEPHEN WONG*	*PERCY LAM*
1	MANAGEMENT COMMITMENT & STYLE	WARREN ANDERSON ESTHER HO	T.L. HO	J.MELDRUM H.L. LAU	K.P. TO
2	MEASUREMENT GOAL & BENCHMARKINBG	KK RAMAMOORTHY & ALBERT HO	KEVIN LAU & PETER TSO	MAY SUM, EMIL JEONG, T.S. CHUNG & BOB SMITH	SOLOMON SO & RONNIE WU
3	COMMUNICATION, PROMOTION & QUALITY WEEK	K.L. PAU & K. LUK	C.Y. CHAN	Y.K. YU & K.Y. FUNG	BONAP MAN & AMAS WONG
4	CONTINUOUS IMPROVEMENT THROUGH PEOPLE PARTICIPATION (WIT)	S.T. NG	K.Y. PANG	KENNY MAK & C.T. WONG	CARRICK LEUNG
5	EDUCATION & TRAINING	ANITA LEE	K.L. POON	KENNETH HO & PETER MA	ROBBIE CHAN & W.F. TSUI
6	RECOGNITION, CELEBRATION & EMPLOYEE SATISFACTION	EVA LAU & K.N. LAU	H.K. LEUNG	ALFRED LO & Y.N. WU	BENNY CHAN & T.M. IP
7	RESPONSIVENESS & SPEED OF EXECUTION	PATRICK PANG	W.C. LAI	VINCENT TSE, K.K. YUNG & ERIC LAU	BOSCO CHENG, ALICE YEUNG & S.K. TONG
8	RENEWAL (REVIEW, RENEW AND DO IT AGAIN AND BETTER)	REBECCA SIU & JEANNE LAM	S.L. LO	HUMPHREY LEUNG	C.M. LIN & PERCY LAM

DATE: Aug 31, 1993
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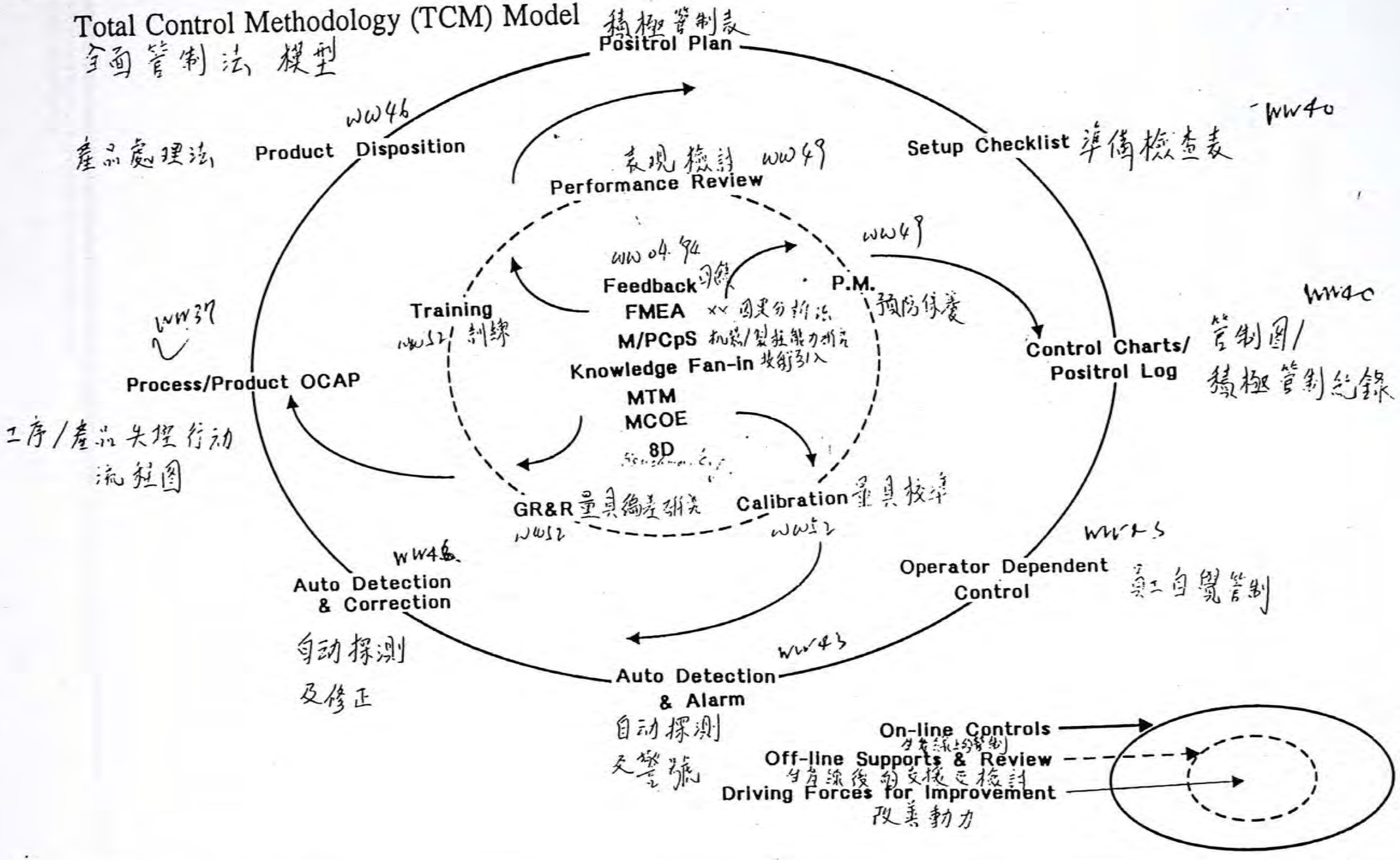
_____ DOMAIN LEADER _____ DOMAIN CO-LEADER

Appendix 3

Total Control Methodology (TCM) Model
全面管制法 模型



Appendix 4

QSR/ISO9001 Cross-Reference Guide

The following is a cross-reference guide between the requirements of the Motorola QSR Guidelines and comparable requirements of the ISO9001 — 1987. This cross-reference is to be used as a reference guide only and is not intended to imply an exact, one-to-one correlation of specific requirements between the two documents.

MOTOROLA QSR	ISO9001 — 1987
SUBSYSTEM 1.0 ELEMENTS	**ISO PARAGRAPHS**
1.1	4.1.1, 4.1.2 and 4.2
1.2	4.1.1, 4.1.3, 4.18 and 4.20
1.3	4.1.3
1.4	None
1.5	4.1.1, 4.1.2.1, 4.1.2.3 and 4.2
1.6	4.14
1.7	4.1.3, 4.14, 4.17 and 4.4.2.2
1.8	4.1.2.2 and 4.18
1.9	4.20
1.10	None
1.11	None
SUBSYSTEM 2.0 ELEMENTS	**ISO PARAGRAPHS**
2.1	4.4.1, 4.4.2 and 4.4.2.1
2.2	4.4.5
2.3	None
2.4	4.3
2.5	4.4.4 and 4.4.2.2
2.6	4.4.5 and 4.20
2.7	4.4.3
2.8	4.4.5
2.9	4.5.1
2.10	4.4.5 and 4.3
2.11	4.4.4 and 4.4.5
SUBSYSTEM 3.0 ELEMENTS	**ISO PARAGRAPHS**
3.1	4.6.3
3.2	4.10.1 and 4.6.2
3.3	4.6.3
3.4	4.6.2
3.5	4.6.1
3.6	None
3.7	4.7
3.8	4.6.4
3.9	4.9.1
3.10	4.9.1 and 4.18

MOTOROLA QSR	ISO9001 — 1987
SUBSYSTEM 4.0 ELEMENTS	**ISO PARAGRAPHS**
4.1	4.9.1 and 4.14
4.2	4.5.2, 4.8. 4.9.1, 4.12 and 4.17
4.3	4.10, 4.4.3, 4.16 and 4.19
4.4	4.15.1
4.5	4.20
4.6	4.14
4.7	4.14
4.8	4.13
4.9	4.9.1
4.10	4.9.1 and 4.18
4.11	4.15
SUBSYSTEM 5.0 ELEMENTS	**ISO PARAGRAPHS**
5.1	4.16 and 4.4.2.2
5.2	None
5.3	None
5.4	4.1.3
5.5	4.9.1 and 4.14
5.6	None
5.7	None
5.8	4.16
5.9	4.14
SUBSYSTEM 6.0 ELEMENTS	**ISO PARAGRAPHS**
6.1	4.18
6.2	4.14
6.3	None
6.4	None
6.5	4.20
6.6	4.14
6.7	None
SUBSYSTEM 7.0 ELEMENTS	**ISO PARAGRAPHS**
7.1	4.11
7.2	4.11
7.3	4.11
7.4	4.11
7.5	4.11
7.6	4.11
7.7	4.11
7.8	4.18
7.9	4.11
7.10	None

MOTOROLA QSR SUBSYSTEM 8.0 ELEMENTS	ISO9001 — 1987 ISO PARAGRAPHS
8.1	None
8.2	None
8.3	None
8.4	4.18
8.5	4.18
8.6	4.18
8.7	None
8.8	None
8.9	None
8.10	None

SUBSYSTEM 9.0 ELEMENTS	ISO PARAGRAPHS
9.1	None
9.2	None
9.3	None
9.4	None
9.5	None
9.6	4.1.3, 4.14 and 4.17
9.7	4.14
9.8	4.1.3 and 4.17
9.9	None

SUBSYSTEM 10.0 ELEMENTS	ISO PARAGRAPHS
10.1	4.4.1
10.2	4.4.2
10.3	4.4.3 and 4.4.4
10.4	4.4.3
10.5	4.4.6
10.6	None
10.7	4.4.5
10.8	None
10.9	4.3, 4.4.3, 4.4.4 and 4.4.5
10.10	None
10.11	4.18
10.12	4.6.4 and 4.10.1

QSR GENERAL SCORING MATURITY MATRIX

SCORE	EVALUATION DIMENSIONS		
	APPROACH	DEPLOYMENT	RESULTS
POOR	■ NO SYSTEM/PROCESS EVIDENT ■ NO MANAGEMENT RECOGNITION OF NEED	■ NONE	■ INEFFECTIVE
WEAK	■ BEGINNINGS OF A SYSTEM/PROCESS ■ A FEW FACTORS IN PLACE ■ MANAGEMENT HAS BEGUN TO RECOGNIZE THE NEED	■ FRAGMENTED ■ DEPLOYED IN SOME AREAS OF THE BUSINESS	■ SPOTTY RESULTS ■ SOME EVIDENCE OF OUTPUT
FAIR	■ DIRECTION FOR SYSTEM/PROCESS DEFINED ■ WIDE BUT NOT COMPLETE SUPPORT BY MANAGEMENT	■ LESS FRAGMENTED ■ DEPLOYED IN SOME MAJOR AREAS OF THE BUSINESS	■ INCONSISTENT BUT POSITIVE RESULTS IN AREAS DEPLOYED
MARGINALLY QUALIFIED	■ A SOUND SYSTEM/PROCESS IN PLACE WITH EVIDENCE OF PREVENTION ACTIVITIES ■ SOME MANAGEMENT BECOMING PROACTIVE ■ EVIDENCE OF ELIMINATING ORGANIZATIONAL DISCONNECTS	■ MOST MAJOR AREAS OF THE BUSINESS ■ MOSTLY CONSISTENT	■ POSITIVE MEASURABLE RESULTS IN MOST MAJOR AREAS ■ SOME EVIDENCE THAT RESULTS ARE CAUSED BY APPROACH
QUALIFIED	■ WELL DESIGNED/PROVEN SYSTEM/PROCESS WHICH IS PREVENTION BASED WITH EVIDENCE OF REFINEMENT AND IMPROVEMENT AND RENEWAL ■ MAJORITY OF MANAGEMENT IS PROACTIVE ■ TOTAL MANAGEMENT SUPPORT	■ PERVASIVE AND CONSISTENT ACROSS ALL MAJOR AREAS OF THE BUSINESS	■ EVIDENCE THAT EFFORTS ARE SUCCESSFUL ■ ALL REQUIREMENTS FULFILLED ■ DEMONSTRATED POSITIVE AND SUSTAINED RESULTS
OUTSTANDING	■ EXCEPTIONAL WELL DEFINED, INNOVATIVE SYSTEM/PROCESS THAT ANTICIPATES CUSTOMER NEEDS ■ MANAGEMENT PROVIDES ZEALOUS LEADERSHIP ■ RECOGNIZED EVEN OUTSIDE THE COMPANY	■ PERVASIVE AND CONSISTENT ACROSS ALL MAJOR AREAS OF THE BUSINESS; BOTH INTERNAL & EXTERNAL	■ REQUIREMENTS EXCEEDED ■ WORLD CLASS RESULTS ■ COUNSEL SOUGHT BY OTHERS

Evaluation Work Sheet: Quality System Management

ORGANIZATION: DATE: SUBSYSTEM: 1 - Quality System Management		FACTOR RATING (R)						APPLICABILITY	SCORE
		POOR	WEAK	FAIR	MARG. QUAL.	QUALIFIED	OUTSTANDING		
NO.	DESCRIPTION	0	2	4	6	8	10	(A)	(RxA)
1.1	Is there a Quality Function or well defined organization which provides customer advocate guidance to the total organization and is this position fully supported by management?								
1.2	Does the organization have detailed goals, tactics, methods and tools to achieve corporate Six Sigma standards in the required time frame, including administrative and non-manufacturing areas? Are programs and results reviewed frequently?								
1.3	Does a quality measurement system exist with clearly defined metrics and is it utilized as a management tool?								
1.4	Are benchmark and customer satisfaction studies done to determine best-in-class for all products, services and administrative functions, and are goals set so that quality is a competitive weapon?								
1.5	Are there Quality Policies, Procedures Manuals and accepted standards which are currently maintained and utilized throughout the organization and is there a management representative or representatives with authority and responsibility for ensuring compliance to these policies and standards?								
1.6	Are there programs with sufficient resources assigned to support corrective actions and prevention in order to achieve best-in-class satisfaction to the customer?								
1.7	Are there regular management reviews of elements of the quality improvement process, including feedback for corrective action and are the results acted upon?								
1.8	Is management's support of ongoing training (including quality training) sufficient and is it documented by an organizational training plan?								

Evaluation Work Sheet: Quality System Management

ORGANIZATION:

DATE:

SUBSYSTEM: 1 - Quality System Management

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
1.9	Do management's requirements and actions lead the entire organization to fully understand and practice the concepts of Six Sigma?								
1.10	Does management attach equal importance to administrative quality systems as to product/service quality systems?								
1.11	To what extent does management solicit, accept and reward feedback from the work force?								
								SCORE	
								Subsystem Rating (Score/10)	100

Evaluation Work Sheet: New Product/Technology/Service Development and Control

ORGANIZATION: DATE: SUBSYSTEM: 2 - New Product/Technology/Service Development and Control		FACTOR RATING (R)						APPLICABILITY	SCORE
		POOR	WEAK	FAIR	MARG. QUAL.	QUALIFIED	OUTSTANDING		
NO.	DESCRIPTION	0	2	4	6	8	10	(A)	(RxA)
2.1	Do new product/technology/service development policies and procedures exist and do they result in clearly defined project plans with appropriate measureables and approvals?								
2.2	Is quantitative benchmarking used to evaluate all new product/technologies/services in comparison to best-in-class offerings?								
2.3	Does a roadmap exist to ensure continued development of leading edge, best-in-class products/technology/services?								
2.4	Are all customer satisfaction requirements formally and fully defined and documented, and are they based on customer inputs?								
2.5	Is the capability of each operation which controls critical-to-function characteristics for new products, fully qualified?								
2.6	Are statistical tools used in the development of robust new products/services?								
2.7	When a new product/technology/service requires a new process to produce it, are they developed jointly and concurrently?								

Evaluation Work Sheet: New Product/Technology/Service Development and Control

ORGANIZATION:

DATE:

SUBSYSTEM: 2 - New Product/Technology/Service Development and Control

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
2.8	Are computer simulation and design tools used to the maximum extent practicable in the design of new products/technologies/services?								
2.9	Is the new product/technology/service and the process for producing it, properly documented to ensure consistent reproducibility of the product/ technology/service?								
2.10	Are design reviews conducted on a scheduled basis and do they properly address the process capability indices of critical-to-function characteristics								
2.11	Is the new product/technology/service, as produced by the process, verified to meet all customer satisfaction requirements?								
								SCORE	
								Subsystem Rating (Score/10)	100

Evaluation Work Sheet: Supplier (Internal or External) Control

ORGANIZATION:

DATE:

SUBSYSTEM: 3 - Supplier (Internal or External) Control

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
3.1	Are requirements defined, communicated and updated to ensure that the supplier understands expectations?								
3.2	Does a system exist which measures the performance of the supplier and communicates such information to the supplier?								
3.3	Have the organization's processes been characterized to identify the critical requirements for the suppliers products?								
3.4	Have the capabilities of the supplier's processes been assessed and considered in the establishment of the requirements?								
3.5	To what extent have suppliers been involved early in the product design/development process?								
3.6	Have quality and cycle time metrics and improvement goals been established participatively with the supplier?								
3.7	Has a system been established with the supplier for identification and vertification of corrective action?								
3.8	Have the requirements for supplier materials been properly characterized and specified to ensure conformance of the product/service to the customer satisfaction requirements?								
3.9	Is there an effective supplier certification program or equivalent procured material/service continuous quality improvement program?								
3.10	Can all personnel who contact suppliers properly reflect appropriate quality improvement programs and status to them?								
								SCORE	

Subsystem Rating (Score/10) 100

Evaluation Work Sheet: Process Operation and Control

ORGANIZATION:

DATE:

SUBSYSTEM: 4 - Process Operation and Control

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
4.1	Are regular reviews of the product/process conducted and are goals/plans established to continually improve at the required rate?								
4.2	Are the processes/products properly documented and controlled? Do they include appropriate customer requirements and are they executed in conformance to the documentation?								
4.3	Are the required quality checks built into the operations within the manufacturing, field installation and service process, and is the resulting data maintained and promptly acted upon?								
4.4	Is the work area uncluttered and free of excess work-in-process, supplies, debris, etc? Is the environment conducive to producing quality work? Is proprietary information adequately protected?								
4.5	Are all pertinent methods of statistical quality control properly, effectively and efficiently used?								
4.6	Are the procedures that control the reaction to process and product out of control situations adequate and effective?								
4.7	Are final acceptance procedures documented, controlled and followed, and are all specified customer product audits conducted as required?								
4.8	Is non-conforming material properly identified, segregated from regular production material and properly dispositioned?								

Evaluation Work Sheet: Process Operation and Control

ORGANIZATION:

DATE:

SUBSYSTEM: 4 - Process Operation and Control

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
4.9	Does a process change control system exist and are customer informed of changes made to products and processes with customer approval, when required, prior to the change?								
4.10	Are the operators within the process provided with written work instructions and are they trained to perform outstanding work?								
4.11	Is the receipt, handling, storage, packaging and release of all material including customer provided items, at all stages, specified and controlled to prevent damage or deterioration and to address obsolete material?								
							SCORE		

Subsystem Rating (Score/10): 100

Evaluation Work Sheet: Quality Data Programs

ORGANIZATION:

DATE:

SUBSYSTEM: 5 - Quality Data Programs

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
5.1	Is there an active quality data system in place to measure performance against the organization's key initiatives?								
5.2	Is the quality data provided in a timely manner?								
5.3	Is the data summarized to meet the needs of the user?								
5.4	Is the quality data reviewed at management meetings, i.e. operations reviews? Are actions assigned based upon the data?								
5.5	Is a system in place to adequately communicate the quality data to all employees? To follow progress versus goal? To measure trends?								
5.6	Is an effective cost-of-quality system used?								
5.7	Is the quality data perceived to be accurate by the user?								
5.8	Are approved procedures for identification, collection, storage/maintenance and disposition of all quality data and records established and maintained?								
5.9	Is customer failure and field performance information recorded and used for corrective action?								
							SCORE		
							Subsystem Rating (Score/10)	100	

Evaluation Work Sheet: Problem Solving Techniques

ORGANIZATION:

DATE:

SUBSYSTEM: 6 - Problem Solving Techniques

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
6.1	Are enough people adequately trained in problem solving techniques in comparison to the need of the organization?								
6.2	Does the organization utilize participative problem solving techniques to identify, measure and resolve internal and external problems?								
6.3	Are problem solving efforts timely and effective?								
6.4	Are sufficient resources applied to problem solving and have all significant problem solving constraints been removed?								
6.5	Are statistical techniques used throughout the organization for problem solving?								
6.6	Is qualify data used to identify and determine the priority of problems?								
6.7	Is there a policy/procedure the includes the use of problem solving techniques to systematically drive reduction in variability aimed at Six Sigma capability?								
							SCORE		

November, 1992

Subsystem Rating (Score/10) 100

Evaluation Work Sheet: Control of Quality Measurement Equipment and Systems

ORGANIZATION:

DATE:

SUBSYSTEM: 7 - Control of Quality Measurement Equipment and Systems

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
7.1	Are all measurement equipment/systems maintained, serviced and calibrated to ensure consistent quality standards?								
7.2	Is there a properly documented calibration control system with effective audits?								
7.3	Is there a properly documented and effective preventative maintenance system for all equipment/systems?								
7.4	Are calibration and maintenance facilities adequate?								
7.5	Are all tools and fixtures used as criteria of acceptability of product/work fully qualified and identified?								
7.6	Are calibration intervals defined in accordance with industry standards or manufacturer's recommendations and the calibration history of the equipment?								
7.7	Is the use of non-calibrated equipment properly controlled?								
7.8	Are calibration and/or maintenance personnel fully qualified and available in sufficient quantity?								
7.9	Is the responsibility for maintenance and/or calibration clearly delineated and documented?								

Evaluation Work Sheet: Control of Quality Measurement Equipment and Systems

ORGANIZATION:

DATE:

SUBSYSTEM: 7 - Control of Quality Measurement Equipment and Systems

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
7.10	Are Repeatability and Reproducability (R&R) studies conducted on measurement equipment and systems using appropriate Methodologies? Are Precision to Tolerance (P/T) ratios acceptable?								
								SCORE	
							Subsystem Rating (Score/10)		100

Evaluation Work Sheet: Human Resource Involvement

ORGANIZATION:

DATE:

SUBSYSTEM: 8 - Human Resource Involvement

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
8.1	Does management ensure that all personnel are fully familiar with their role in achieving Total Customer Satisfaction (TCS)?								
8.2	Do all personnel know how their performance impacts internal and external customer satisfaction?								
8.3	Can all personnel who contact external customers properly reflect quality improvement programs (such as Six Sigma)?								
8.4	Are sufficient personnel participating in professional societies and growth programs?								
8.5	Are all personnel trained in sufficient detail to support key initiatives?								
8.6	Are the results of training properly evaluated and indicated program changes made?								
8.7	Does a policy exist which encourages the cross training and rotation of personnel and is this policy used as the basis of job progression?								
8.8	Are proper performance standards (including customer satisfaction standards) participatively developed and regularly applied for all personnel?								
8.9	Are Total Customer Satisfaction programs and resulting successes publicized to all personnel?								
8.10	Do goal setting and reward/incentive programs properly support the quality improvement process?								
							SCORE		
							Subsystem Rating (Score/10)	100	

Evaluation Work Sheet: Customer Satisfaction Assessment

ORGANIZATION:

DATE:

SUBSYSTEM: 9 - Customer Satisfaction Assessment

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
9.1	Is there a measurement system in place to effectively assess the customer's perception of our complete performance?								
9.2	Is an independent (unbiased) competitive image survey routinely conducted?								
9.3	Is there an internal measurement system within the organization which correlates to the level of customer satisfaction?								
9.4	Are there specific goals for achieving Total Customer Satisfaction, both internal and external?								
9.5	To what extent are customer satisfaction goals disseminated and clearly understood by everyone in the organization?								
9.6	Does management regularly review and assess all operating systems to determine if barriers to customer satisfaction exist and are appropriate action plans then implemented?								
9.7	Is there a method for forecasting future customer expectations?								
9.8	Are all findings of customer dissatisfaction reported back to the proper organization for analysis and correction action?								
								SCORE	
								Subsystem Rating (Score/10)	100

Evaluation Work Sheet: Software Quality Assurance

ORGANIZATION:

DATE:

SUBSYSTEM: 10 - Software Quality Assurance

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
10.1	Is an approved, documented process used to guide the development and maintenance of all software that impacts Total Customer Satisfaction?								
10.2	Are software project planning and control mechanisms in place and followed?								
10.3	Is software developed as part of a total system using a phased development approach, intermediate deliverables, and review and approval based on entry and exit criteria?								
10.4	Is software developed in support of documented (formal, written, approved, updated, and available) requirements with conformance to these requirements verified?								
10.5	Is software developed and maintained under documented plans for configuration management and change control, including installation and customer configuration?								
10.6	Is software developed using proper tools and documented, approved procedures for security and information recovery, including disaster protection?								
10.7	Does software undergo system/acceptance testing by individuals or organizations not directly involved in the design or implementation of the product being tested? Does testing reflect customer usage?								

Evaluation Work Sheet: Software Quality Assurance

ORGANIZATION:

DATE:

SUBSYSTEM: 10 - Software Quality Assurance

NO.	DESCRIPTION	FACTOR RATING (R) POOR 0	WEAK 2	FAIR 4	MARG. QUAL. 6	QUALIFIED 8	OUTSTANDING 10	APPLICABILITY (A)	SCORE (RxA)
10.8	Are there established goals for software quality including Six Sigma performance as the overall goal? Do the measurement systems provide tracking of progress towards these goals as well as highlight quality issues from the customer perspective?								
10.9	Does the quality assurance organization act as a customer advocate in software matters by assuring conformance to customer requirements and specifications and proper execution of the approved development process?								
10.10	Is there a mechanism used to ensure continuous software development process improvement?								
10.11	Is there a capability improvement program in place for all software organizations, including deployment and assessment of training?								
10.12	Is the process used by software subcontractors under control, and is conformance to requirements of subcontracted software verified?								
								SCORE	
								Subsystem Rating (Score/10)	100